ILLUMINATING ENGINEERING

AUGUST, 1950

◆

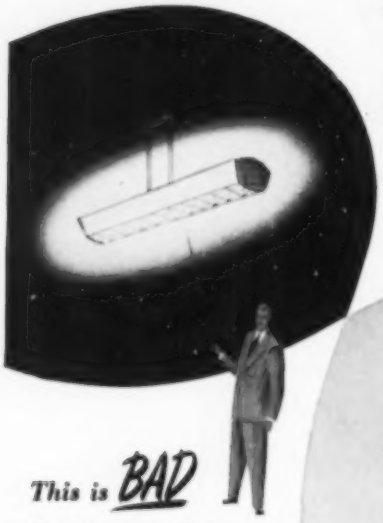
Evolution of a Shoe Store Lighting System
Techniques of Lighting Small Stores
Luminous Ceilings at Brown Univ.
Public Lighting Aesthetics in Europe
Sunlighting Church Windows at Night
U-V for Bactericidal Purposes
Munsell Reference Colors

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

How the Wakefield STAR provides

Brightness Balance

which is the key to the
Co-ordinated Classroom



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Brightness Balance

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This is GOOD Brightness Balance

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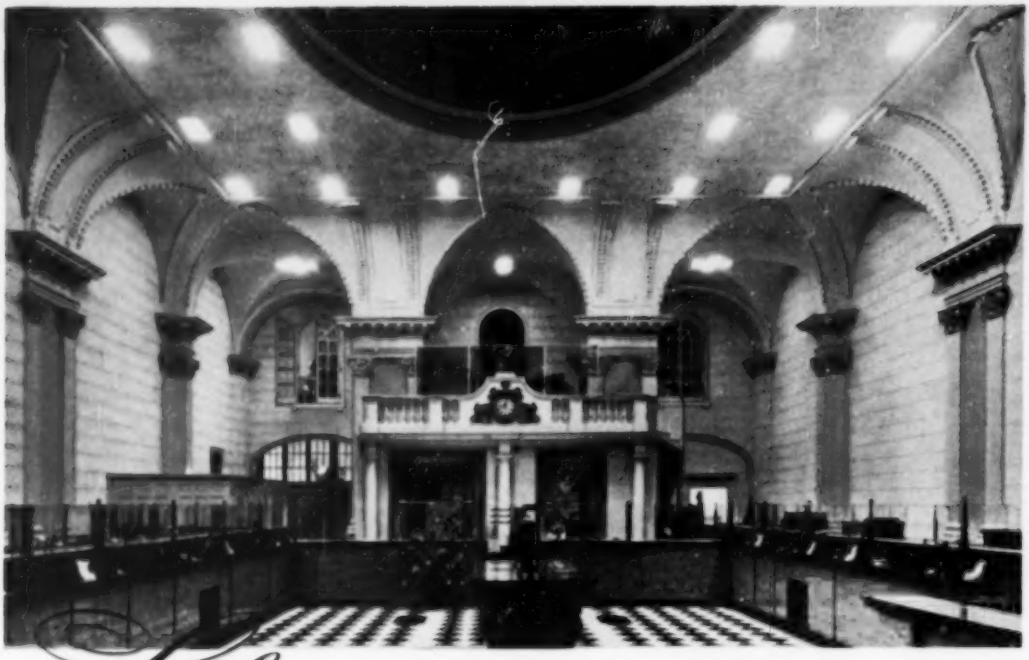

Light on an old banking problem

BRIGHT and friendly is the interior of this bank since it was given new life with properly designed lighting. Though the soaring ceiling presented a problem, Litecontrol engineers solved it with incandescent lens boxes. These fixtures blend smoothly into the architectural design — give a narrow concentrated beam that easily bridges the gap between ceiling and floor. Certainly an excellent solution to the old problem of relighting older style buildings.

Shown is the Merchants National Bank, Salem, Massachusetts

Architect, W. H. Jones & Son, Melrose, Mass.; Engineer, John R. McVey, Salem Electric Lighting Company; Electrical Contractor, Wilson & Robinson; Distributor, DesRoberts Electric Supply Company. Ceiling height: 24½ feet. Fixtures: 24, 2 gang recessed lens boxes for top service with Holophane 21765 lens-reflector combination. Designed for 300 watt incandescent lamps to provide an average of 35 footcandles in service in work areas.

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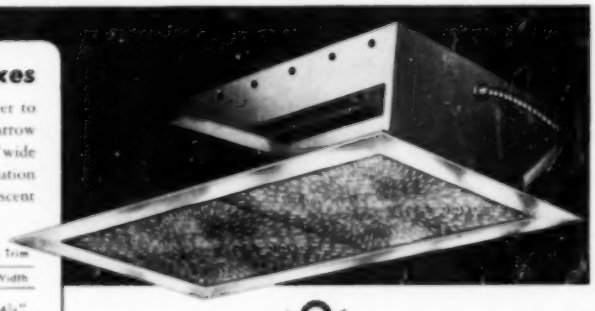
12F-V30-3	3-150*-300	37"	12⅛"	11⅛"	39"	14⅞"
*12F-V30S-3	3-150*-300	37"	12⅛"	11⅛"	39"	14⅞"
12F-V30-4SQ	4-150*-300	26"	26"	12"	28"	28"
*12F-V30S-4SQ	4-150*-300	26"	26"	12"	28"	28"

*Supplied with Holophane Square Reflector for wide beam spread.
†Use ½" Socket Extension. Note all mass boxes available with top service for relamping from above.



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ILLUMINATING ENGINEERING

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

AUGUST
1950

Vol. XLV
No. 8

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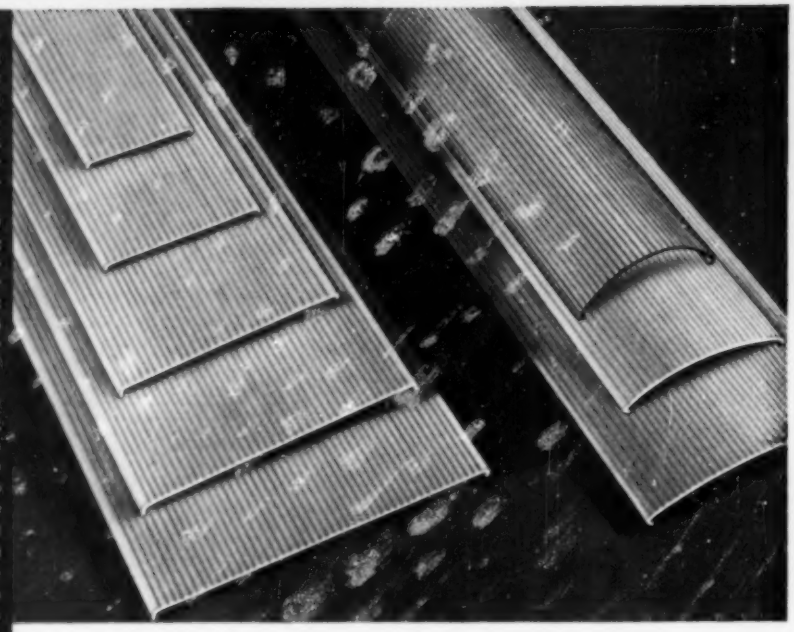

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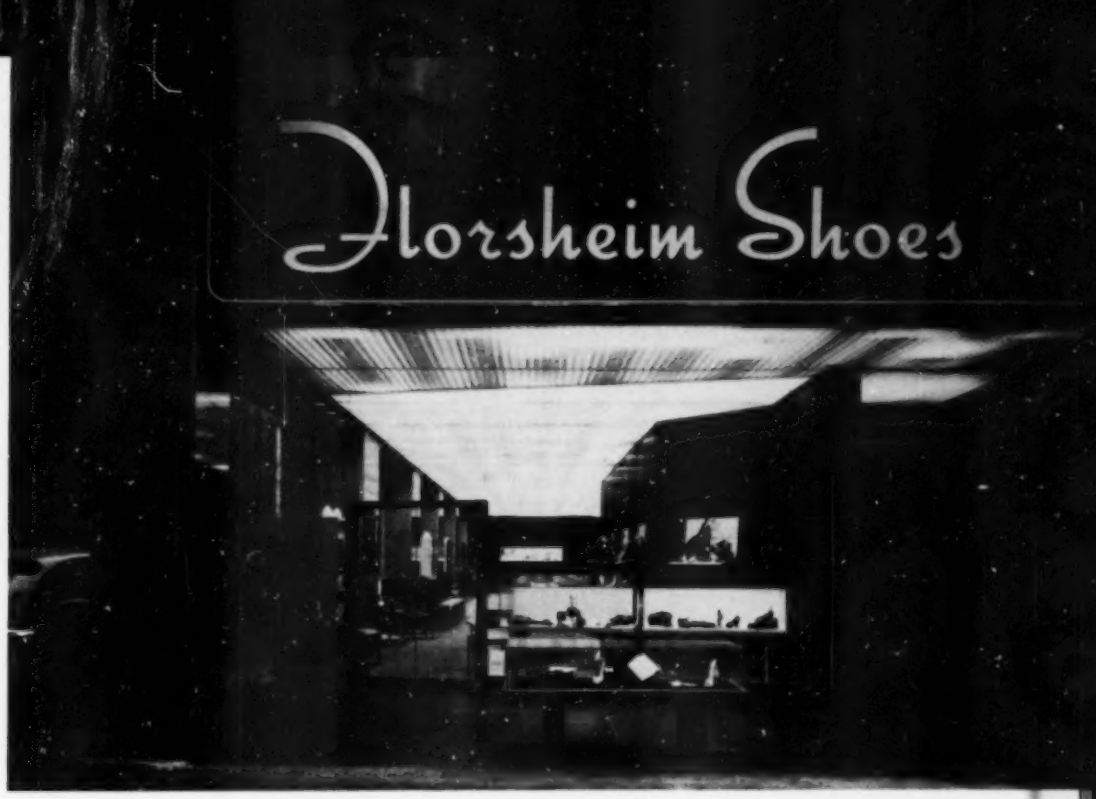


Techniques of Lighting Small Stores

By MORRIS KETCHAM

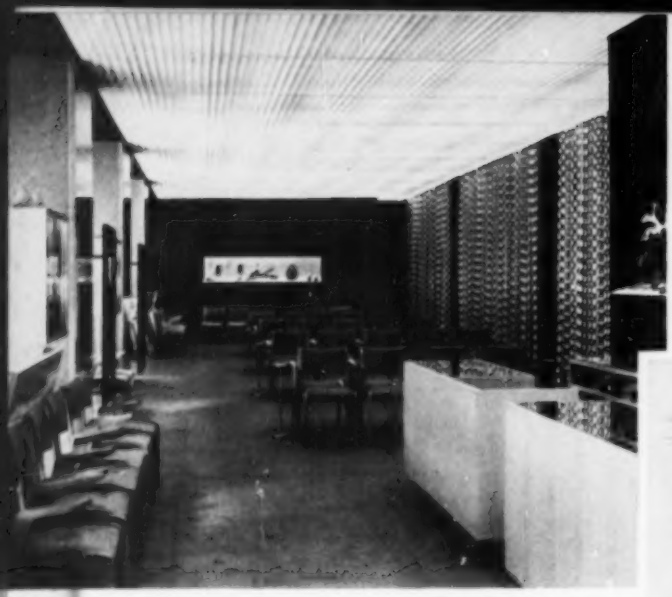
IF EITHER a shop or a stage were suddenly plunged into darkness, the show would stop instantly. The performance or the day's sales would be ruined. Both stores and theatres owe their existence to artificial illumination. It has been a long time since daylighted market places or open air theatres met the demands of drama and trade. Both types survive for occasional and limited use; neither could exist on Broadway or Fifth Avenue.

So dependent are we on artificial lighting for our shops and stores that when daylight is available, as in the open faced shop, we must measure it out and direct it just as carefully as we do any other illumination within the sales area. Outdoors, such devices as awnings, overhangs, and recessed store fronts are used to filter or stop incoming sunlight; indoors, the calibre of artificial lighting must be stepped up and carefully distributed to counteract incoming daylight. Were it not for the demands of outdoor advertising and display, we would enclose all our sales areas within opaque walls, as in the theatre, in order to create the same completely controlled lighting environment.

The fundamental reason for this is that a store interior is literally designed like a stage. The actors are the goods on display and sale; the audience is the crowd of shoppers who move in and around the sales area; the scenery is the sales backgrounds; the lighting problems are basically the same. As in the theatre, the chief problem is to keep audience attention focused on the story told by the acting troupe — the merchandise.

In a theatre, however, the audience stays quietly in one spot during the performance. In a store, shoppers are constantly on the move from one aisle to another. Their vision and attention are constantly shifting. The merchandise is also not concentrated on a single stage, but scattered through-

Based on a lecture presented before the New York Section of the Illuminating Engineering Society, May 18, 1950. MR. KETCHAM is a member of the American Institute of Architects and a prominent architect in New York City with Ketcham, Gina & Sharp.



Florsheim's, Fifth Avenue, New York, exterior of which is shown on the preceding page, was one of the pioneer louverall ceilings. Some 75 footcandles is supplied.

out the arena where customer and clerk meet over the sales counter. This constant movement complicates the lighting problem. There are very few fixed backgrounds for focal displays. A few high walls, a few props, a few sales fixtures, still provide backdrops, but more and more of the merchandise must be seen — and lighted — from all sides.

In shops and stores, as in the theatre, there are two types of lighting: general lighting to illuminate "scenery" for atmospheric effect, and intense focal lighting to accent players or merchandise. Both types must be instantly available when needed; both must be capable of flexible and multiple use. With these tools, architect and lighting engineer can provide store management with the means to create the entire atmosphere and character of a shop, and the power to vary them from week to week or from day to day.

In arriving at the right lighting solution for a shop or store, the architect first organizes space, structure and equipment for merchandising, then determines the lighting program. In a new store building he will have to create all three elements; in a modernization project, space, structure and equipment exist, and his problem will be their alteration and improvement. In either case, after the elementary issues of sales department locations, customer and service traffic flow, and sales and service equipment have been settled, his primary design tool is lighting and all the colorful display effects that lighting can give. He is then ready to set the stage for merchandising, indoors and out. Since small shops are better source material for the clinical analysis of store lighting, three such projects are illustrated here.

In the corner shoe shop shown above and on page 479, interior space was frozen by existing limitations, but the only fixed points on the store front were the columns supporting the office building above and the building entrance. The opportunity existed to place an elegant salon on full view at one of the best and busiest locations on Fifth Avenue.

Interior and exterior were organized to minimize the pullman-car proportions of the sales area. The narrow Fifth Avenue frontage was enlarged by pulling back the store front to form a shopping arcade, and by incorporating the building entrance within this outdoor lobby. The narrower part of the sales space near the entrance forms the accessories department; the wider area at the rear becomes a more spacious salon for shoe sales. Finally, the open store front on both streets redeems the long narrow plan by destroying the visual boundaries of the interior sales area.

The now familiar device of unifying exterior and interior was worked out by means of a pioneer application of the louverall lighting system. From the innermost corner of the shop to the outer edge of the arcade, the entire ceiling is an unbroken light source. A grid of metal egg-crate louvers shields a formidable mass of fixed fluorescent lamps supplemented with movable incandescent spotlights. The fluorescents alone supply 75 footcandles

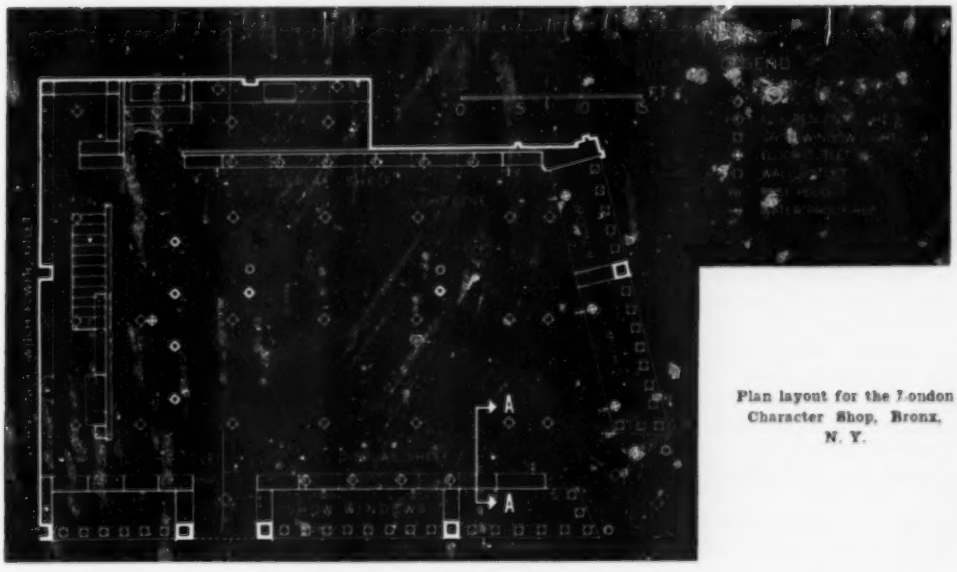
of light on the selling floor. Outdoors in the arcade, the fluorescent lamps change to cold cathode to meet the demands of cold weather conditions. Additional incandescent spots are fixed over the store front and arcade display cases.

When a small shop is treated as a show window, as this was, a louverall ceiling can be effectively used provided there are not too many glass topped sales fixtures on the floor. We have never used it indiscriminately on large interior sales floors because its 45° visual cut-off — an excellent device at normal eye level — is no protection against the mirror-like reflection of its exposed light sources on a glass counter top.

In the next small shop, the London Character Shop located in the Bronx, men's shoes and hosiery instead of women's shoes and accessories are on show. Again the problem was to develop a fixed spatial area contained within the walls and ceiling of an existing corner store; again the exterior envelope consisted in an unalterable pattern of show windows and entrances. The space within, however, formed a simple rectangular cube. Program requirements were for a more formal, severe, and richly simple interior.

The lighting solution is simple but effective. Around the perimeter of the main sales area, a continuous double line of fluorescent lamps placed in a plaster cove provides general illumination. This light source is supplemented by recessed incandescent floodlights in the main ceiling and by built-in incandescent spotlights in wall niches and show windows. Fluorescent strips in a shielded cove flood the hosiery displays with light.

London Character Shoe Store, Bronx, N. Y., is another example of problems encountered with fixed architectural elements. Here perimeter and accent lighting have transformed the area.



Plan layout for the London Character Shop, Bronx, N. Y.

In Florsheim's Chicago, at left and below, the problem of enlarging existing space was solved by a new hung ceiling which conceals fluorescent lighting around the perimeter. Interior columns are mirrored.

The cove lighting throws an even glow over the entire ceiling that in turn washes out the brightness of the incandescent downlights. Together, these light sources provide even illumination for gray-green carpet, gray leather, mahogany woodwork and yellow rows of shoe boxes along the walls. The accent lighting is focused on the merchandise and on the screen wall.

In planning another small shop for the Florsheim Shoe Company in Chicago (shown at right) the problem was to enlarge and re-equip a store selling women's shoes and accessories. Two existing rental spaces were to be combined as one new unit. Total space was frozen by existing boundary walls and ceiling and by a store front that the landlord regarded as sacred and unalterable.

Window shopping traffic could be attracted from both busy shopping streets next to the corner location. An entrance to the building's elevator lobby provided a minor source of customer traffic. Some space was required behind the scenes for reserve stock and a manager's office; the remainder of the interior area was available for sales.

The accessories department with its impulse merchandise was placed adjacent to both a street and a lobby entrance; the shoe sales area was placed around the corner but within view. On the exterior, we opened up the existing show windows and entrances for better display and successive glimpses of the interior. Show window lighting was improved and intensified with the installation of incandescent downspots in the larger openings, metal louvered ceilings concealing a combination of incandescent and fluorescent sources in the smaller show windows.

On the interior, we decided to use atmospheric lighting to emphasize background walls, to leave the ceiling in comparative darkness, and to reserve our strongest accent illumination for the merchandise on display. Recessed fluorescent lamps run the full length of all walls except for that which acts as a background for the accessories department. A pattern of incandescent floods recessed in the ceiling provides even illumination for the entire sales floor, adding sparkle to polished leather footwear. The light grey carpet kicks back a glow of light to the comparatively low ceiling above.

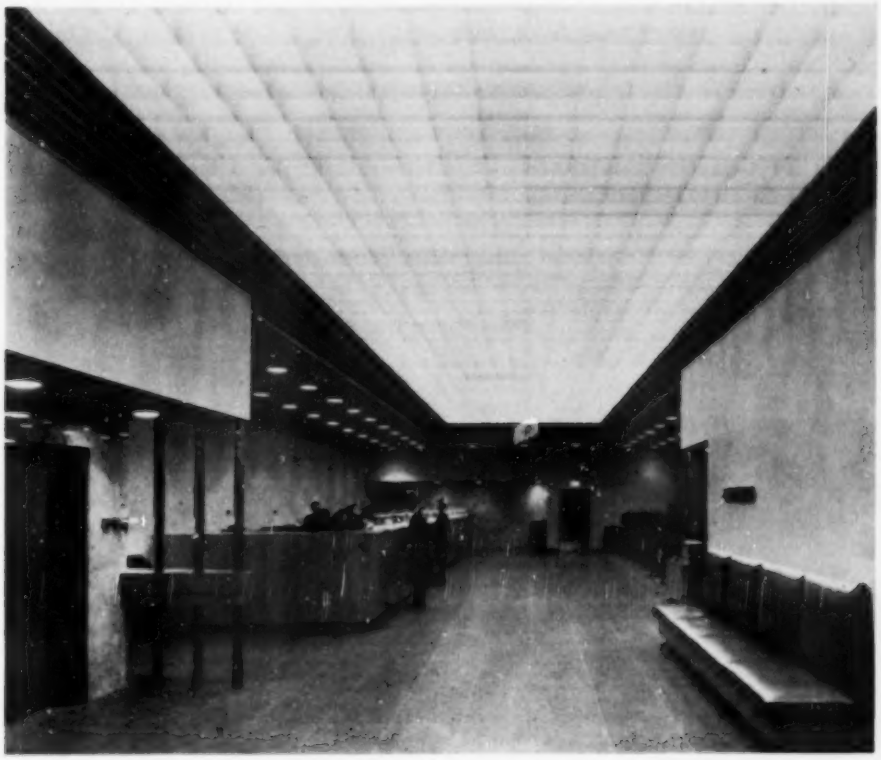
This basic lighting system produces a quiet, restful atmosphere throughout the shop. The ceiling appears to float over the sales area; the walls to glow, the displays alone stand out in brilliant contrast.

By way of variety and special emphasis, the dark walnut reeding of the accessories department wall is illuminated only by reflected light spilling out from its own focal displays. The light sources here are bullet-shaped suspended incandescent spotlights.

Throughout the shop, a wide range of architectural elements — merchandise, casework, wood, fabrics, lighting — were utilized to transform a matter-of-fact space into a rich, colorful environment for merchandising.

Lighting a Bank

LIGHTING OBJECTIVE: To provide a comfortable and attractive illuminated environment for banking transactions in keeping with modern architecture.



Installation at Central National Bank of Cleveland, Ohio. Architect: Conrad, Hays, Simpson and Ruth; electrical contractor: Martien Electric Company, Cleveland

General Information: The 96-foot long general banking area is decorated as follows:

desk tops	white oak	35% RF	walls	white oak	35% RF
	green linoleum	13% RF		green plaster	42% RF
furniture	red leather	7% RF	ceiling	acoustical tile	60% RF
	brown leather	8% RF		above louverall ceiling	70-75% RF
files	grey	8-10% RF	floor	grey terrazzo	14% RF
				patterned green carpeting	15% RF

(over)

A.I.A. File No. 31/14

Installation: General illumination for the circulation area is provided by 40-watt warm white fluorescent lamps mounted in continuous rows on 2-foot centers 14 inches above the top of a grid composed of brushed aluminum cells 13 x 13 x 9 inches (manufactured by Frink Corporation, Long Island City, New York). Bottoms of louvers are 14 feet above floor. Sixty-two 150-watt filament downlights shielded by concentric-ring louvers (manufactured by Curtis Lighting, Inc.) are recessed into the dropped-ceiling area (12 feet above floor) surrounding the central louverall area. Downlight spacing is either 3½ or 6 feet, with lamps staggered when two rows of units are installed in parallel (over tellers' cages and side desks). Supplementary illumination for check desks is provided by two wall-mounted troffers each containing two 40-watt lamps. In addition, tellers' counters have edge-lighted glass signs containing 6-watt fluorescent lamps.

Two months after installation the average illumination with all lamp circuits in use was:

circulation area	50 footcandles
counters	40 "
check desks	60 "

Brightnesses are indicated below:

louvers	
maximum, viewed at 60 degrees	90 footlamberts
minimum, viewed at 30 degrees	30 "
downlights	
maximum, viewed at 40 degrees	330 "
ceiling between downlights	2 "
floor	5 "
files and safes	1-5 "

Lighting data submitted by W. E. Conley, General Electric Company, Buckeye Sales District, Cleveland, Ohio as an illustration of good lighting practice and to aid in the design of similar installations.

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Series XV 8-50

Special Shields Meet Standards But— Stock Item Proved Better

By LELAND H. BROWN

IN APRIL, 1949, a rather intensive brightness study of luminous indirect office lighting was made at the offices of the Pacific Gas and Electric Company, San Francisco. The equipment had been in use for several months and had been installed with the objective of minimizing reflected glare. The study was to determine what had been achieved in that direction and to find the degree in which the installation conformed to the Recommended Practice.

The tests showed puzzling results because the average brightness of the luminaires came out about 50 per cent higher than values reported in the manufacturer's literature. It was so puzzling that densitometer measurements were taken of the films that constituted the photographic record. These measurements showed that the original brightness measurements were consistent. Since that had not cleared up the mystery, it was decided to re-standardize all the instruments and repeat the test.

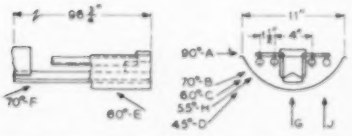
The second test, made on the night of July 15, 1949, yielded results practically identical with the first one, an average reflector brightness of 265

DR. BROWN is a Consulting Illuminating Engineer, Palo Alto, Calif.

LAMPS - FOUR - 118 VOLTS; 3950 LUMENS; 300 MA; 96" T-8 4500° WHITE FLUORESCENT.

UNIT - SYNTHETIC ENAMELLED METAL CHANNEL; CURVED RIBBED PLASTIC BOTTOM; ALZAK ALUMINUM COVERED BALLASTS.

TEST - CANDLEPOWER DISTRIBUTION IN THREE VERTICAL PLANES INTERSECTING IN THE CENTER OF THE UNIT; A-A NORMAL, B-B PARALLEL AND C-C 45° TO THE TUBES.



LUMINAIRE DISTRIBUTION DATA

MEAN VERTICAL

MID-ZONE ANGLES	CANDLEPOWER AT 40 FEET	ZONAL LUMENS	MID-ZONE ANGLES	CANDLEPOWER AT 40 FEET	ZONAL LUMENS
180° ZEN.	3020		90° HOR.	163	
175°	2950	280	85°	128	140
165°	2780	786	75°	134	142
155°	2560	1185	65°	171	169
145°	2240	1407	55°	211	189
135°	1870	1447	45°	249	193
125°	1470	1319	35°	283	176
115°	1180	1170	25°	311	144
105°	845	894	15°	329	93
95°	340	371	5°	338	32
			0° NADIR	338	

LIGHT FLUX VALUES

ZONE	LUMENS/LUMINAIRE	PERCENT	ZONE	LUMENS/LUMINAIRE	PERCENT
0°-30°			0°-90°	1280	8.1
0°-40°	447	3.0	90°-180°	8859	56.0
0°-60°	829	5.2	0°-180°	10139	64.0

LUMINAIRE BRIGHTNESS

THE ARROWS INDICATE THE LOCATION AND ANGLE OF VIEW

ANGLES	A	B	C	D	E	F	G	H	J
FOOT LAMBERTS	590	180	180	180	136	90	90	180	180

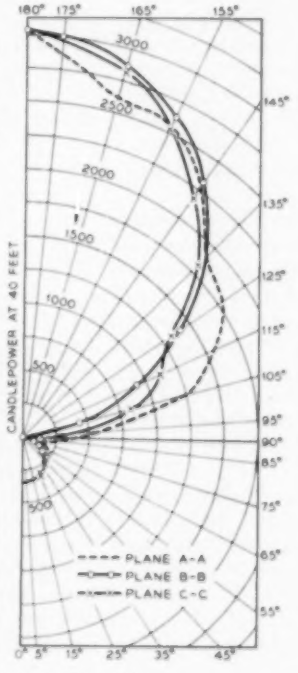


Figure 1. Photometric report of standard low brightness luminaire.

Figure 2 (Left). Looking south-east down the length of the room. Figure 3 (Right). Looking north-east up the length of the room. Most of the workers have this view of the room as they sit at their desks.

footlamberts though the manufacturer's quoted value was 180.

It was only after this second test that it was learned that the reflectors were not standard but special because the owners had wanted luminaires with a greater downward component of light and the manufacturer, therefore, had supplied reflectors made with a different plastic of higher transmittance which, of course, caused higher brightness readings.

Obviously, it is rather important to have established these preceding facts before moving into the account of the conditions, tests, and conclusions which follow.

About five people occupy the office, doing work that varies from conferences, reading and preparing reports, to dictating, typing and filing. The illumination from daylight alone is often inadequate as it may drop as low as 10 footcandles during regular office hours, consequently the fluorescent lighting is used at all times.

The fluorescent lighting system consists of four continuous rows, 12 feet long, of luminous plastic reflectors of the semi-indirect type. Each luminaire carries four 4500K slimline fluorescent lamps six feet long, operated at 300 ma from 120-volt mains by two-lamp ballasts.

At the time of the second test, the lamps in the luminaires had burned approximately 2000 hours and the reflectors had been cleaned just a week before. Reflectance measurements showed that the dust that had subsequently collected on the reflectors lowered their reflectance by six per cent.

The room reflectances, measured with a Taylor Reflectometer, are tabulated below along with the range of reflectances specified in the Recommended Practice. Only the floor failed to meet the recommendations.

TABLE I.

Surface	Color and Finish	Reflectance in Per Cent In Room 429	Recommended by I.E.S.
Ceiling	White Acoustical Plaster	79	85 (75-85)
Walls	Ivory Paint on Plaster	68	
	Weighted Average (Walls, Windows, and Doors)	59	60 (50-60)
Desk Tops	Buff Paper	35	35
	Light Oak	30	
Furniture	Light Oak	30	35 (30-35)
Floors	Blue Gray Rug	17	20 (20-30)
Luminaire Reflector	With Dust	59	
	After Cleaning	63	

The first test had shown that brightness contrasts were at a maximum when daylight was excluded, so the second test was run after 8 p.m. at night. A recording voltmeter showed that the voltage remained constant throughout the test at 120 volts. Likewise a recording light meter and a portable color corrected illuminometer showed that the average illumination on the desk tops was constant that evening at 47 footcandles. In similar offices, where ordinary seeing tasks are the rule, the Recommended Practice of Office Lighting calls for 30 footcandles.

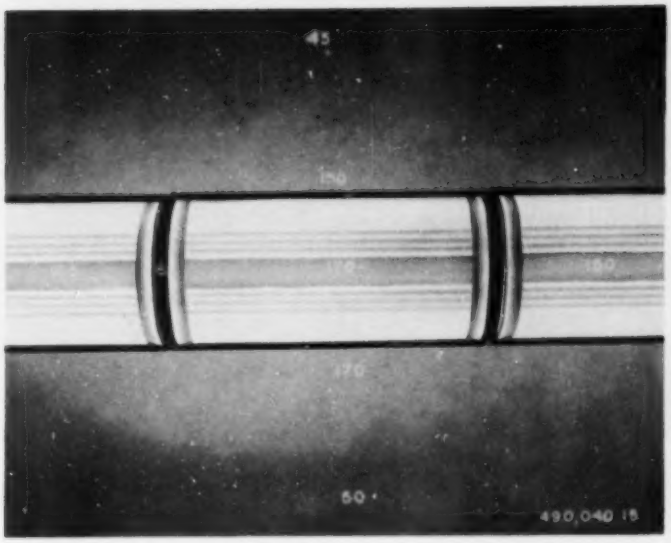


Figure 4. Looking vertically upwards from underneath a luminaire. This is the brightness pattern that would be reflected by a glossy desk top located under the luminaire. The low brightness ratio between the brighter plastic and the darker background of the ceiling proves that reflected glare in minimized in this office.

In every case the measurements were made at the same point that the camera occupied when the photographs were taken. Brightness ratios for areas of appreciable size (10 square feet or more at 10 feet) were calculated and tabulated as follows: with the corresponding recommended values shown also.

TABLE II.—Brightness Ratios.

	Room 429	I.E.S. Recommended Practice
Between task and adjacent surroundings	2.3 to 1	3 to 1
Between task and more remote surroundings	4.4 to 1	10 to 1
Between luminaire and task	9.1 to 1	Not specified
Between luminaires and surfaces adjacent to them	16.0 to 1	20 to 1
Anywhere within the normal field of view (Luminaire to rug)	40.0 to 1	40 to 1
Maximum brightness ratio in the room for areas of any size (Brightest luminaire to Line-A-Time)	291.0 to 1	Not specified

Ratios Meet Recommended Limits

The brightness ratios found in the office do meet the recommended limits. However, the low reflectance of the rug makes the brightness ratio between it and the luminaires the maximum recommended.

Fig. 4 records the luminaire and ceiling brightness than would be reflected from a glossy desk top or glossy seeing task. The brightness ratio for these special plastic reflectors was only 6½ to 1, hence reflected glare was no problem in this office under test. Had the manufacturer's standard low brightness plastic reflectors been used, the brightness ratios between luminaire and ceiling would have been only about 4 to 1.

It will be noted that the satin-finished aluminum frames have a rather low brightness at most view angles, due to the spread reflectance characteristic of the satin aluminum. The diffuse reflectance of the ivory finish frames that are available from the same manufacturer make them brighter at most viewing angles and consequently the preferable ones from the lighting standpoint.

Conclusions

These tests showed that the design, decoration and lighting of this office using the special light density plastic semi-indirect reflectors meet all of the specifications of the I.E.S. Recommended Practice of Office Lighting with the exception of the floor covering which is too low. However, even it was high enough to keep the maximum brightness ratio anywhere in the visual field down to the 40 to 1 value specified.

Calculations show that had the denser standard reflectors of the manufacturer been used, the average maintained illumination of the desks would have been at least 43 footcandles as compared with the measured 47 footcandles from the special reflectors. This difference in illumination is rather negligible. On the other hand, the brightness ratios between luminaire and task and between luminaire and adjacent surfaces would have been reduced by about a third. This would have added much to the visual comfort of the workers.

Lastly, and perhaps most important, reflected glare is quite absent when the standard low brightness plastic reflectors are used.

One-Hundred Years of Lighting at Pagel's Shoe Store

By D. M. HOFFMAN

BACK IN THE DAYS when an "illuminating engineer" was the fellow who kept the black off the glass lamp chimneys, Pagel's Shoe Store in Philadelphia had the latest in lighting — kerosene lamps. That was in 1879.

Since then, the store has kept abreast of the changing art, installing new lighting with every advance. Planning their latest modernization, shown in the large pictures at the top of these pages, was one of my most interesting lighting jobs.

The store received its first change when carbide lamps were used in 1898. Corrosion on the burners made maintenance difficult, and these were discarded after a couple of years, and the gas-light installed.

A picture of the store at its next modernization in 1904, is shown inset, upper left. Electricity had been installed, but was not fully trusted.

An atmosphere of entirely different character is created for the Men's Shop, by incandescent lighting and a decor contrasting markedly from the front of the store.

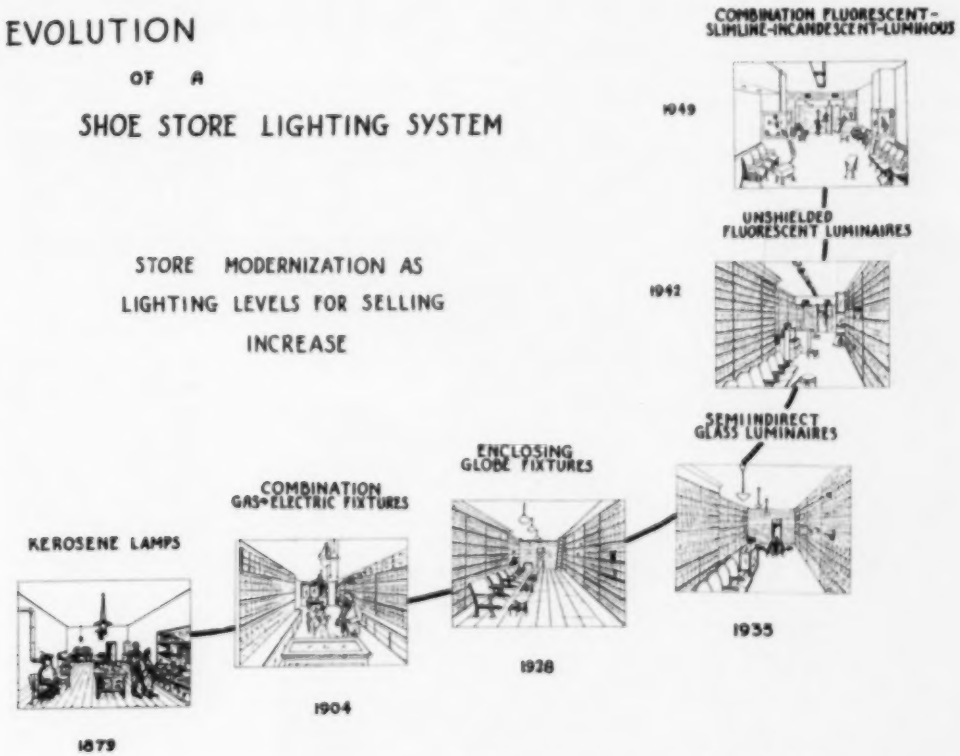
Note that the gas mantles were retained, as a stand-by.

In 1928, realizing that his store had again become antiquated, Mr. Pagel remodeled once more. He replaced the furniture, recovered the floor, removed the floor cases, and installed the newest and most improved type of glass enclosing globes for lighting. This installation is pictured at left, center.

No photograph was available for the store's next change, in 1935, since lighting was the only change made. The previously modern illumination was replaced that year with glass semi-indirect luminaires.

Unshielded fluorescent fixtures were the next change, in 1942, when the store was again relighted and redecorated. This installation is shown at the lower left.

A complete transformation was undertaken recently, with the lighting forming a part of the over-all improvement, rather than just a change.



As can be seen from the "before" pictures, the store proportions were not very satisfactory. Lighting changes throughout the years raised the footcandle levels, but did little or nothing for the appearance of the store. With an optimistic feeling that "nothing is impossible" we made several tentative layouts. The success of the modernization plans arrived at is due in no small part to the excellent cooperation and close collaboration of the owner, the store designer and the lighting specialist.

Shoe stock was removed from the walls to an enlarged area in the rear, shortening the overall length of the store (an improvement in the proportions) and at the same time widening it by several feet. Even with the addition of ten more chairs, the store is now less crowded than before.

Separate Men's and Women's Departments have been created with lighting effects of two distinctive characters. The pictures speak for themselves on this point.

In the Women's Department, general lighting in character with the decor is supplied by three 96-inch four-lamp 425-ma shielded luminaires. Four 150-watt double PAR 38 spot units provide accent lighting. The soffit uses six 100-watt lamps in downlights, and three 150-watt R40 recessed downlights brightly illuminate the entrance. Niche and mirror lighting is provided by one-lamp fluorescent channels. General lighting levels in this area are 56 footcandles, with 150 footcandles in the accent areas. The display niches are lighted to a level of 45 footcandles and the entrance downlights provide a level of 65 footcandles.

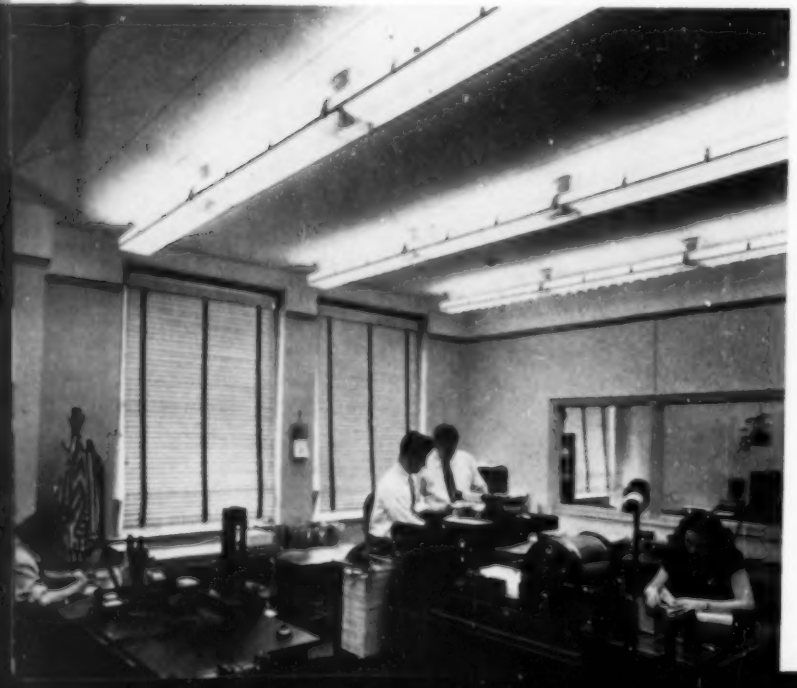
The decor of this department also completely "separates" it from the Men's Department. Serrated plywood paneling has been painted first pink, allowed to dry, and white paint then applied and lightly rubbed off while still wet. Reflection factors of this mottled pink surface are 68 per cent. The ceiling is white with a reflectance of 84 per cent; the carpet is rough pebbled grain light gray in color, with a reflection factor of 19 per cent.

The Men's Shop achieves an entirely different atmosphere. Lighting design and typically "masculine" decoration creates a mellow effect with low reflectance (28 per cent) knotty pine paneling and recessed mirror glass incandescent louverall reflector units. The general lighting level average in this department is 25 footcandles, with 71 footcandles provided at the cashier's counter.

The entrance to this area is made more inviting by the novel illuminated display niches painted a dark maroon having a reflectance of 14 per cent. These niches are illuminated to a level of 33 footcandles.

To increase the attraction of the store at night, after it is closed, the wall niche cases are wired to the window time clock, to be illuminated every evening.

This installation was judged the winner of the contest for "My Most Interesting Lighting Job" conducted by the East Central Region. Representing the Philadelphia Section's entry, it was presented at the Regional Conference, May 19. MR. HOFFMAN is with the Lighting Applications Section of the Philadelphia Electric Co.



The Public Service Company of Cleveland, Ohio, has lighted its office service section — a room 20′ x 21′ — effectively and pleasantly to an average of 75 footcandles. This installation consists of four rows of luminaires, on 6¼″ suspensions, 5′6″ spacing, each luminaire containing two 40-watt 3500K fluorescent lamps. The walls are painted light green; the 10′6″ ceiling is acoustical tile. Lighting data and photo courtesy of F. W. Wakefield Brass Co., Vermilion, Ohio.

Ultraviolet Radiation for Bactericidal Purposes

By H. M. ARCHER

A Review from the standpoint of a public utility.

ULTRAVIOLET radiation usage discussed in this review relates only to germicidal and fungicidal control, for it is in these fields that the public finds its greatest interest.

Man has known for centuries that, in some inexplainable way, the sun's light was beneficent — for growing green plants — for inhibiting fungus — for healthy animal life. Recent studies have verified this knowledge by careful consideration of the effects of the sun's radiations.

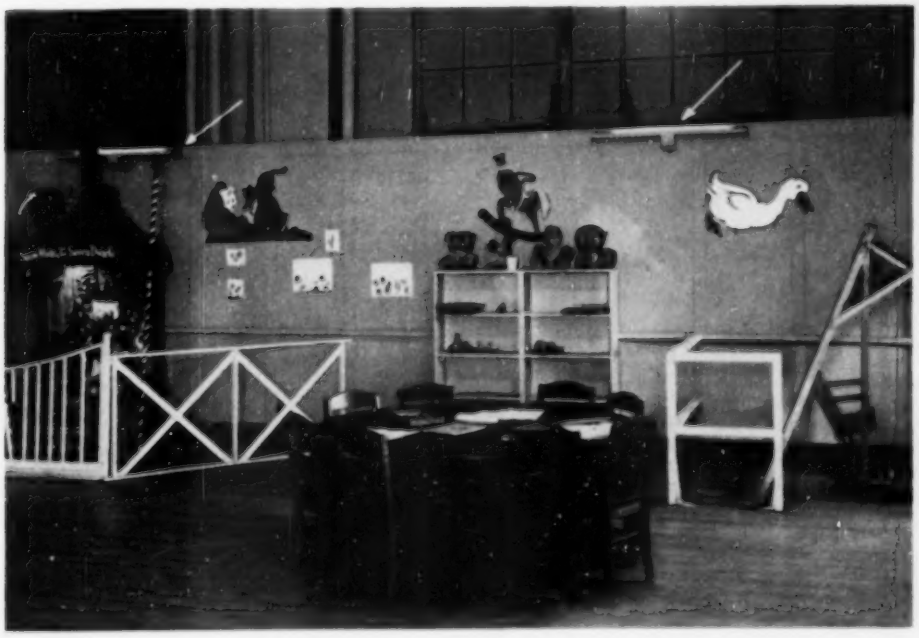
As early as 1870, however, qualitative work was started to learn the reasons for these beneficent phenomena; to determine which wavelengths of the sun's radiations reaching the earth were most effective in retarding fungus and bacterial slimes. It was ascertained then, that the blue end of the visible spectrum was a more effective bactericidal agent than the red end. When ultraviolet sources became available through the electric arc at the turn of this century, these studies were carried over into the ultraviolet and beyond those wavelengths reaching the earth (3000A and shorter).

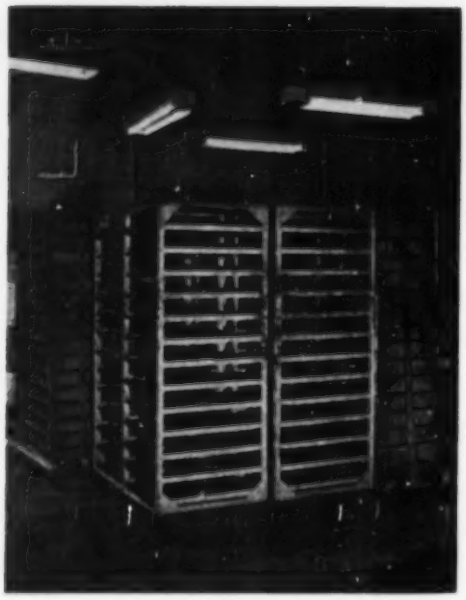
More recent studies have shown that the peak of the bactericidal action occurs at 2650A, falling off rather sharply on each side of this peak to a minimum occurring at 2200A in the short wavelength direction and reaching a practical zero in the red portion of the visible spectrum.

It must be remembered that the bactericidal action of these radiations is a function of exposure, that is, the product of the intensity of the radiation and the time during which the radiation is in

MR. ARCHER is with the Research Dept. of the Detroit Edison Co., Detroit, Michigan.

Figure 1. Ultraviolet equipment in use in a day nursery as an aid for reducing the live bacteria count in the air.





action. Thus, although the bactericidal effect of the radiation falls off as it approaches the wavelengths normally present in sunlight, the much greater intensity available in radiations from the sun makes its action quite evident despite the lesser unit effect.

By good fortune it happens that one of the resonance lines of low-pressure mercury vapor, when ionized, occurs at 2537A. This is somewhat different from the peak of the bactericidal curve occurring at 2650A, but is sufficiently close so that the action is approximately 75 per cent of that at the peak.

The exact mechanics by which these radiations accomplish their killing is not thoroughly understood. The theory has been advanced, however, that the complex molecule comprising the bacteria, or in some cases the virus in question, is so constructed that fractional portions of it have a mechanical resonance approaching that of the frequency of the ultraviolet radiation being used, with the result that a rupturing of the molecules comprising the bacteria occurs, causing its death.

Medical Research

One of the early investigators into the use of ultraviolet radiations for germicidal purposes was W. F. Wells, of the University of Pennsylvania. Dr. Wells and his wife conducted many experiments both in the laboratory under carefully controlled conditions and in schools in their neighborhood, with lesser controlled conditions, to determine the effect of ultraviolet radiations in killing air-borne bacteria and reducing the cross-infection between people. The results of Drs. Wells' experiments substantiated the theory that a cross-infection rate reduction could be accomplished

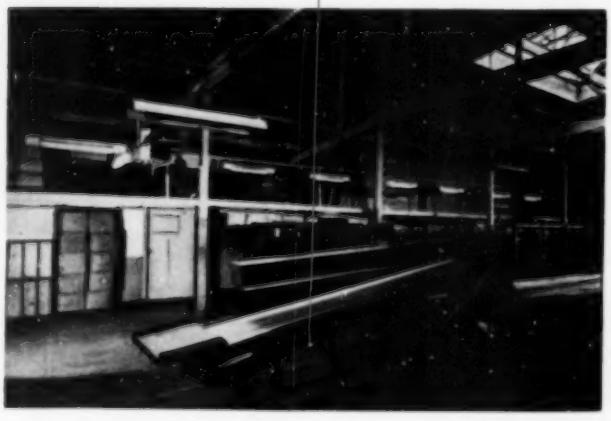


Figure 2. An ultraviolet installation for preventing bacterial and fungus growths in a pie-making plant. The fillings for the pies and the pies themselves are irradiated at all stages. (Top) Irradiation of the pie filling. (Center) Irradiation of the pies while cooling. (Right) Irradiation of the wrapping conveyor.

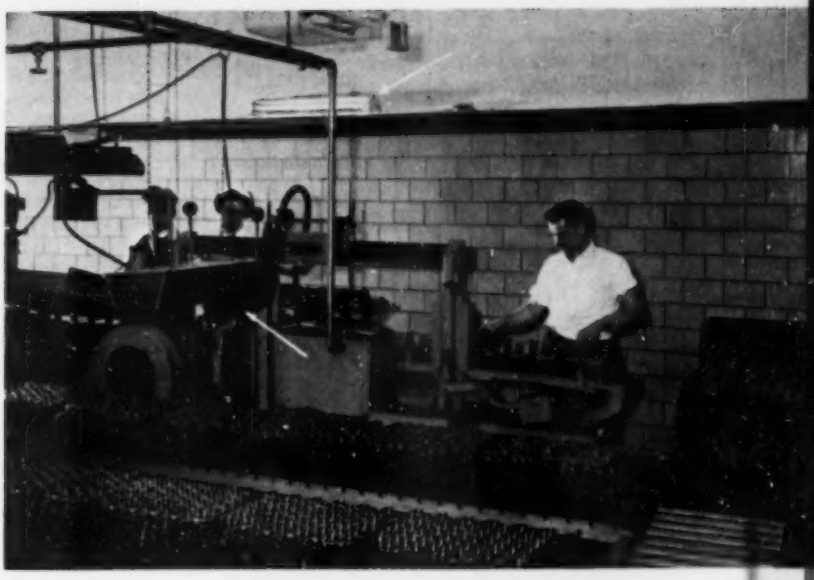


Figure 3. Ultraviolet equipment used in an olive processing and packing plant for reducing fungus and bacterial growth on the walls and equipment.

in school rooms irradiated with suitable amounts of ultraviolet.

Since that time, numerous schools throughout the country have been equipped with these lamps with varying degrees of success. Currently, a large scale experiment is being conducted in Pleasantville, New York, to determine if an entire community might be benefited by the widespread use of ultraviolet radiations. All of the stores, theatres, and schools have been equipped with ultraviolet radiation devices. So that the prevalence of cross-infection outside the irradiated areas may be measured, Mount Kisco, a town of similar proportions near Pleasantville, is being used as a control. Investigators working with ultraviolet radiations are watching this experiment with considerable interest.

A review of the mass of literature on the subject reveals the following general conclusions:

a. Ultraviolet radiations at 2537A possess a powerful bactericidal and fungicidal effect.

b. In rooms and living spaces containing air-borne microorganisms, the degree of air contamination can be markedly lowered by the use of ultraviolet radiators.

c. The degree by which the contamination is reduced does not directly control the incidence of respiratory diseases in the space under consideration (*i.e.*, a "little" radiation does not do a "little" good but a sufficient amount can be beneficial).

d. Excessive exposure of living tissue to ultraviolet radiations produces deleterious effects (erythema and conjunctivitis).

e. Some of the engineering aspects of the problem of applying the radiations are still in a state of development. Studies to determine the best methods of installation are still in progress. More installations are needed for observations to determine the best methods of use and intensities required.

Because of the statistically difficult evaluation problem involved in these studies, the medical profession has assumed a cautious attitude toward the widespread public promotion of ultraviolet radiations. The American Medical Association in its *Journal of Physical Therapy*, for example, has indicated the wish that "unscrupulous sales promoters"* be curtailed in their activities relating to the sale of the ultraviolet equipment. This is a laudable attitude so long as it does not curtail into oblivion those activities that can put before the public the intelligent and safe use of ultraviolet radiations. Undue curtailment of promotional activities in this field can seriously restrict the application of ultraviolet radiations in those fields for which its use has been demonstrated, from a practical standpoint, to be beneficial. Such fields are in product control, in the packing and servicing of biologicals under sterile conditions, and in the control of fungus growth in industries handling material subject to attack by these organisms.

The Detroit Edison Company had its start in the ultraviolet radiations field early in the 1930's when one of their research staff manufactured an experimental ultraviolet lamp and used it to demonstrate

*"Acceptance of Ultraviolet Lamps for Disinfecting Purposes," Council of Physical Medicine, A.M.A., 1948.

that the radiations from the lamp were capable of remarkably retarding the growth of bacterial and fungus slimes on a carcass of beef hung at ordinary room temperature. From this modest experiment and the publicity that was given to it was derived incentive for numerous large scale experiments to determine the feasibility of using the radiations from the ultraviolet lamp as a means for controlling bacterial and fungus growths.

Now, fifteen years later, the medical profession and the members of public utilities who have followed the progress of these investigations are cautiously approaching the attitude that these radiations can perform a public benefit but that the technology of the subject must be in the hands of those people well acquainted with its intricacies and equipped with proper instrumentation in order to avoid any undesirable effects that may result from improper use.

Suggested Types of Installation

There are several criteria that can be used to judge the merits of a proposed installation. Having used these criteria to decide the feasibility of a particular installation, it is then ordinary practice to use manufacturer's recommendations as to the type and placement of the ultraviolet equipment.

In presenting these criteria, no attempt has been made to inject the economic considerations that enter into every installation. It is felt that such economic aspects are beyond the scope of this review.

The criteria and discussion of each are:

(a) Are people present in a closed space, breathing air that contains pathogenic air-borne bacteria and by their occupancy increasing the number of air-borne bacteria above desirable levels?

It is a matter of medical record that the direct irradiation of air by ultraviolet energy at 2537A can effect a reduction in the number of live air-borne bacteria almost to zero. It is recognized that continual replenishment of the air-borne bacteria takes place when people are present. In this instance, however, tests have demonstrated that the number of air-borne micro-organisms is reduced to a lower stable level but not zero which is a function of the amount of irradiation, its disposition in the room, and the number of people contaminating the air-space. A contributing factor supporting the amount of sterilizing action is the amount of intermixing of the contaminated portion of the room air with that sterilized by the ultraviolet energy.

(b) If it is intended that the installation be used to reduce the number of live air-borne bacteria, is the geometry of the room or ventilation system suitable for the proper use of ultraviolet radiations?

Although the consideration of item (a) may indicate the desirability of the installation of ultraviolet units, the space may be such that an insufficient fraction of the room volume can be irradiated. Consider for the moment a room of cubic shape with the upper half of the space irradiated. Consider further that the amount of irradiation is such that it sterilizes completely the air in the upper half in the course of one minute. Now assume that once every minute the air in the lower half of the room displaces the equal volume of sterilized air in the upper half of the room.* The displacement of the contaminated air in the lower portion of the room by the upper irradiated air once every minute produces an effective clean ventilation rate of 60 changes per hour. This is a phenomenal rate and would not be tolerable if the usual air-change method were used.

Our practice, as formulated by calculations and practical considerations, has been to recommend that the ultraviolet equipment be installed so that a minimum of 20 per cent of the room volume is exposed to direct irradiation.

*This latter assumption is reasonable since in occupied rooms of usual size a constant movement of air is maintained by ventilation equipment, the movement of people in the room, or other convection currents. Observations of the amount of such room air movement have shown air turnover factors as high as 200 times per hour. The reader is cautioned not to interpret "air turnover" as meaning "air-changes." The first term relates to air movement within a closed space whereas the second relates to the displacement of the air in a room with air from some other space or the out-of-doors.

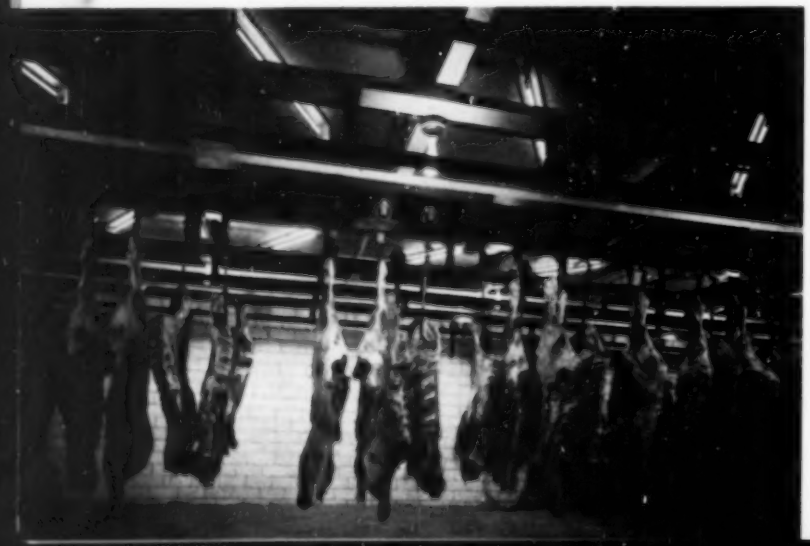


Figure 4. Ultraviolet equipment in use in a large meat holding room for minimizing bacterial and fungus growth.

(c) If the proposed installation is intended for other than air sanitation, have tests been made to demonstrate the effectiveness of the proposed use?

This type of installation includes the sterilization of glasses and cutlery. Also included would be installations in meat hanging rooms for the minimization of fungus and bacterial growths on meat during curing or storage. Installations of this nature have not been investigated as thoroughly as have air sanitation installations. Past experience is too meager in most cases, therefore, to permit the evaluation of a proposed installation by comparing it with previous experience. For example, it is not feasible to determine by visual inspection the degree to which the surfaces of drinking glasses are sterilized by irradiation, although it is recognized that the air around the glasses is maintained in a sterile condition.

(d) What precautions are necessary to eliminate over-exposure of the people and animals that may be exposed to ultraviolet radiations?

Every installation should be considered from the human safety angle before advising the use of ultraviolet radiations.

It is not sufficient that the installation be designed so that the occupants of the room do not receive excessive direct irradiation from the lamp. They should be protected also from excessive indirect irradiation, redirected from u v reflecting surfaces. Actual measurements should be made in each installation to be certain that acceptable energy levels obtain in occupied spaces. Convenient portable ultraviolet meters have been developed for this purpose. (See Fig. 5.) Acceptable energy levels are tabulated in Table I.

Careful consideration of the items mentioned will aid in determining the desirability of a proposed ultraviolet installation. They will not, however, indicate the exact amount of ultraviolet energy required. Such information is available from the lamp manufacturers.

Precautions To Be Observed

It is of primary importance that an ultraviolet installation shall present no physiological hazard* to persons who may be exposed to it. The American Medical Association through its Council on Physical Medicine** has specified a maximum of 0.1 microwatt per cm² for continuous exposure and 0.5 microwatt per cm² for exposures of the order of 7 hours. The values given in Table I are considered safe in all instances including the exposure of infants. In the case of adults acclimated to ultraviolet radiations the values of this table may be exceeded by a factor of two. Field experience in the Detroit area indicates that the A.M.A. premise of 2.4 microwatt hours per cm² per 24 hours is well within the limits of human tolerance. Observations have been made up to intensities as high as 1000 microwatts per cm² to determine the reciprocity effect. As long as the total exposure was 2.4 microwatt hours or less per cm² per 24 hours no erythema or conjunctivitis was experienced.

Figure 5. A typical portable ultraviolet meter. The safety scale "Permissible Hours Exposure" permits the operator to determine at a glance the safety of a particular installation. Other meters that accomplish the same result are commercially available.

It appears necessary to check the individual installations rather than rely on calculations because of the unpredictable effects of side wall and ceiling reflectances. Also to check the possible presence of spurious radiation lobes produced by the fixture that may affect the installation.

Ozone is produced in quantity by the bactericidal lamps during the early part of their useful life. The Council on Physical Medicine of the A.M.A. has indicated that the ozone concentration

TABLE I.—Exposure Allowance per Day.[†]

Exposure time in hours per 24 hours	Intensity microwatts per cm²
24	0.1
12	0.2
8	0.3
6	0.4
4	0.6
3	0.8
2	1.2
1	2.4
0.5	4.8

[†]The allowable exposure for the eyes is suspected to be slightly lower than the values given here. Additional experience is necessary to verify this statement. The values in this table were calculated from the 2.4 microwatt hours per cm² per 24-hour exposure set forth by the A.M.A. Council of Physical Medicine.

*For a comprehensive discussion of the physiological effects of ultraviolet radiations, the reader's attention is directed to "The Chemical Action of Ultraviolet Radiations," Ellis, Wells, and Heyroth, Chapter 26, Reinhold Publishing Corporation.

**J.A.M.A., June 19, 1943, Vol. 122, pp. 503, 504.

should be kept below one part in ten million in any installation. A reasonable rule of thumb in this case is to maintain the ozone content of the air below that value at which the odor is "distinctly perceptible." There is a possibility that the one part of ozone in ten million parts of air may be lowered to a one to twenty-five million ratio as indicated by recent studies. For the present the "distinctly perceptible" condition is acceptable as indicating excessive ozone. Oxides of nitrogen are formed by quartz mercury arcs to a very slight extent.* The literature on the subject points out that ultraviolet radiation in the region 2500A acts as a dissociant of nitrogen oxides. Experience in the field indicates that if oxides of nitrogen are formed by germicidal lamps, the concentration in rooms of normal ventilation is of no physiological importance.

Types of Equipment Available

Generators for producing ultraviolet radiations in the desired spectral region are available in wattages ranging from 4 watts to approximately 300 watts. The most convenient sizes from the standpoint of technical simplicity, operation, and installation, however, range from 4 to 30 watts. Several manufacturers are producing fixtures suitable for use with the several types of lamps available. The lamps are available in two general varieties classified as hot cathode and cold cathode lamps. Either may be used with equal effectiveness in a given application provided that equal radiant energy capacity at 2537A is installed.

The fixtures are designed for various services such as sidewall, ceiling, air duct, or unshielded vertical and horizontal installations.

Approximately two years' field experience with adequate measuring equipment has indicated that the average fixture available to the public is woefully inadequate for the intended purposes. The industry has apparently assumed that the same accuracy of manufacture that is used for lighting equipment is sufficient for ultraviolet equipment. Experience has shown that the ultraviolet fixture must be built to control the radiation output of the ultraviolet lamp to a degree never obtained with other types of lighting fixtures. Spurious lobes cannot be tolerated and reflectors must be accurately shaped and supported to retain their original shape.

This condition of inadequate equipment is not unusual for a new phase of industry, and equipment, properly designed and constructed is now becoming available. In general, the fixtures must be designed to produce a high intensity lobe of radiation in the desired direction with an absolute minimum of spurious radiation. The usual desired lobe direction is slightly above the horizontal (between 5 and 10 degrees) with no radiation below the horizontal and a minimum in the vertical.

The School Question

Since the American Medical Association is nationally recognized as an organization capable of evaluating aids or hazards to the public health, it is natural to look to them as an authoritative source for statements pertaining to the effectiveness of ultraviolet energy for bactericidal purposes. The Council on Physical Medicine* of the A.M.A. in June, 1943 issued a statement entitled "Acceptance of Ultraviolet Lamps for Disinfecting Purposes" in which ultraviolet radiations are recognized as acceptable for air disinfection in hospitals, nurseries, and operating rooms. An excerpt from this release states:

> The Council does not accept ultraviolet lamps for disinfecting air in schools, waiting rooms, industrial plants, barracks, assembly halls, or refrigerators.

At first reading this quotation would appear to imply that such installations are ineffective and undesirable. Further study of the Council's complete statement reveals, however, that they do not forbid such installations but rather wish the public to recognize that the evidence supporting the benefits of such installations as of June, 1943 was incomplete. That this interpretation of the Council's 1943 statement is correct is indicated by a critique that was prepared by W. W. Coblentz** in December, 1945 and published in the *Journal of the American Medical Association* entitled "Ultraviolet Lamps for Disinfecting Purposes, Present Status." An excerpt from Coblentz's critique states:

> ..... ultraviolet radiant disinfection of air can be substituted for actual (clean) air displacement in reducing cross-infection in chickenpox, measles, and mumps, and with less certainty in reducing the incidence of colds, (but) there is no evidence that will justify high pressure sales promotion of ultraviolet disinfecting lamps as a cure-all or sure-shot preventive of respiratory illness.

The current reticent attitude of the A.M.A. in the matter of school and similar installations appears to be one based on the desire to obtain additional clinical evidence and that such installations are not to be considered positive safeguards against the incidence of diseases of a respiratory nature. This is a reasonable condition to place on such installations in view of the fact that school children

*Compt. rendu., 150, 1517 (1910) Berthelot, D. and Gaudechar, H.

*Formerly Council on Physical Therapy.

**Dr. W. W. Coblentz, National Bureau of Standards, Studies in Ultraviolet Bioclimatology. Member Council on Physical Medicine.

can and do come in contagious contacts with their playmates and members of their families outside of the schoolroom. Although respiratory illness may be contracted from contacts outside the schoolroom small children usually do begin their childhood diseases with attendance at school, indicating that their school associations contribute to the disease incidence rate. The installation of bactericidal equipment in the schoolroom therefore represents a good starting point in any program whose object is the protection of the children from cross-infections.

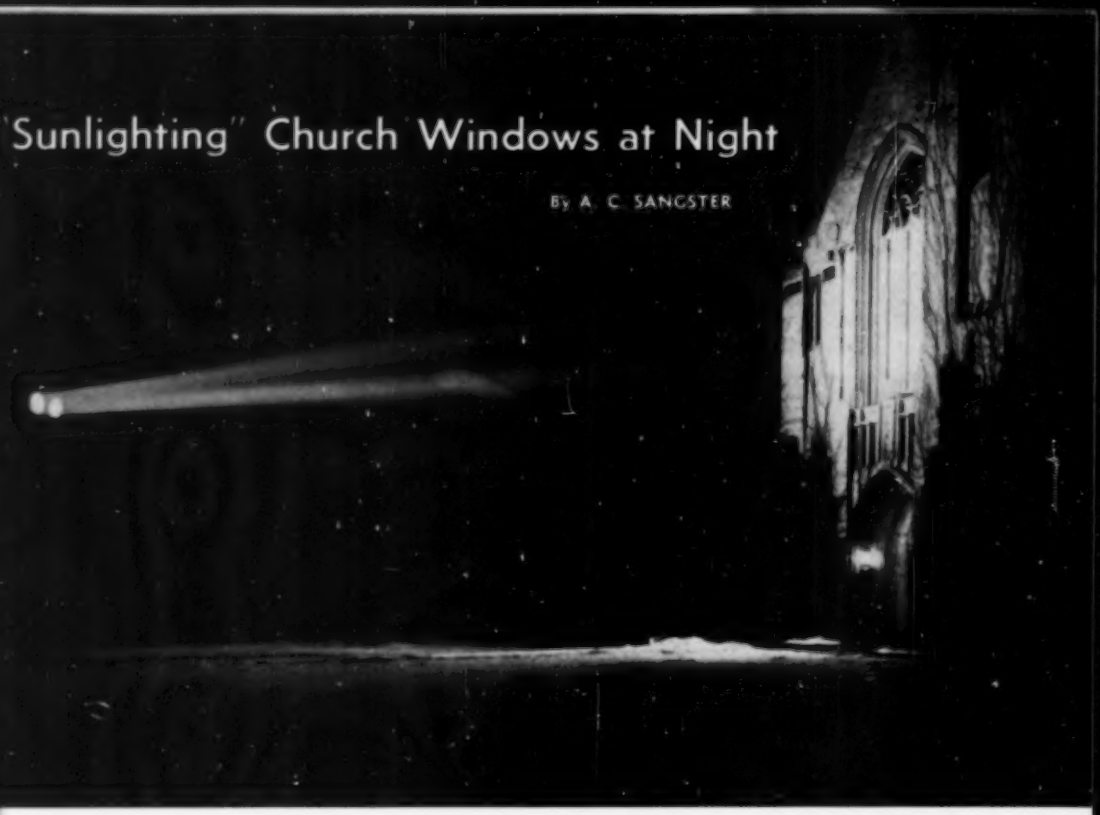
Ultraviolet bactericidal irradiation of the schoolroom and other school activities should be considered experimental and subject to competent supervision until additional evidence has been gathered. At the same time nothing in this discussion should be construed as counter to the desirability of school installations. Evidence has been gathered at the current writing of ten widely separated school installations with beneficial results. Such promising indications support the conclusion that additional installations are warranted and needed to permit a positive statistical analysis.

Relighting the Eastland Baptist Church, Nashville, Tennessee

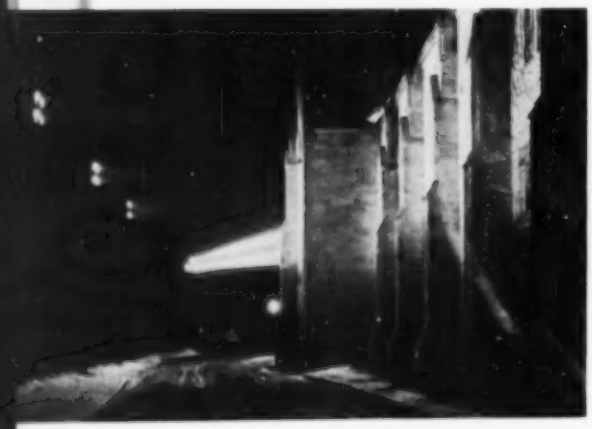
Typical of many of the older churches found today, the Eastland Baptist Church in Nashville was beautiful in basic design but lighted to hopeless inadequacy. To retain and enhance the classic design of the interior but still increase the illumination, a relighting method was selected which supplemented the existing layout. The existing system consisted of a large pendent decorative fixture, of good scale and design, equipped with several large lamps. The major portion of the light output was directed toward the ceiling — thus creating an indirect effect. With this system everything in the room was illuminated to the same low intensity, subjugating the central theme to the rest of the room instead of exalting it. Being of very pleasing and appropriate design, however, this fixture was retained in the relighting plans, to create the proper atmosphere and light the ceiling. For added illumination, flush lens units were installed in the illuminated ceiling where their brightness is low, producing a level of 20 ft-c — adequate for hymnal reading. Immediately in front of the chancel arch have been placed four directional lens units that build up the lighting to still higher values, highlighting the pulpit in a subtle, non-theatrical way. The addition of the flush lens units may be considered an "architecturally neutral" approach, in that they neither add nor detract from the design. All of these units may be relamped from above the 30-foot ceiling, facilitating the servicing. Lighting data and information furnished by S. B. LeCornu, Nashville, Tennessee.

"Sunlighting" Church Windows at Night

By A. C. SANGSTER



Light streams through the beautiful stained glass windows of Christ Church, Grosse Point, Michigan, since this unique floodlighting installation was devised.



AS FAR as I know, few if any, stained glass church windows have ever been floodlighted from outside, for that wonderful effect of light streaming through the colored panes. I myself thought it was a rather impractical application, when Mr. Jack Frost, a progressive electrical contractor in Detroit, asked my assistance in floodlighting all of the stained glass windows of Christ Church in Grosse Point, Michigan. It seemed to me, and to stained-glass specialists too, that the very dense windows with very deep color presented an almost impossible problem.

Acting for a member of the church who wanted this effect for his daughter's candle light wedding service, Mr. Frost stayed with the problem through countless statements that "it can't be done."

We did do it, however, and with beautiful effect, with the aid of Syracuse floodlighting engineers. Their solution included two 2000-watt searchlights per window mounted 22 feet in the air, 100 feet away from the front windows. At this distance the

Winning installation in the contest for "My Most Interesting Lighting Installation" conducted by the Great Lakes Region. The installation was designed and installed by Jack Frost, Detroit electrical contractor. Mr. Sangster is with the Detroit Edison Co.

units floodlighted an area of 64 square feet in a square pattern, with fine cut-off. With a paddle meter, 470 footcandles were measured in the middle of the window.

Motion picture studio lighting units, also 22 feet high and 100 feet away, illuminated the nave windows, two units to each window. All of the equipment used G48 2000-watt lamps. The studio lighting units, of course, being designed for interior use, had to be masked and weather-proofed. For the large altar window, where the glass was denser and the area greater, three searchlight units were employed.

The stained-glass windows thus illuminated were all of Willetts glass, very dense and very deep in color. The artificial lighting through them revealed a beauty never before appreciated. The colors were brighter and small panes in upper corners, not previously noticed, came to glowing life.

The pictures on the opposite page, showing the lighting equipment on the front of the church (large picture at top) and on the south side nave windows, illustrate how unobtrusively the equipment has been installed. On the east side, there is a cloister walk where the equipment was mounted on the roof behind a parapet (picture not shown).

Connected load for the installation is 65 kilowatts. Fortunately there was a primary vault in the building and we had no difficulty in serving the job.

Church windows have always been a tough lighting problem, and perhaps will remain so in many cases. This job did, however, represent a solution to one problem because a good electrical contractor persisted in spite of all the people who told him it couldn't be done.

Above — the altar window from inside. The glass here is denser, requiring three searchlight units mounted 100 feet from outside the window.

The interior of the church at night. This is the beautiful view the bride had as she came into the church and walked down the aisle.

Luminous Ceilings at Brown University

By DOMINA EBERLE SPENCER

A description is given of four rooms that were recently lighted by means of luminous ceilings. The installations were also used in a numerical check of the interflectance method of calculating light distributions.

A PROMISING method of obtaining good visual conditions in an old room with low-beamed ceilings is to employ a uniform luminous ceiling over the whole room and to utilize high reflectances for floor and walls. Four examples of this method of creating a luminous environment are described.

An incidental value of the installations is that they offer a check of the interflection method* of lighting calculation. Experience with these installations shows that ceiling lighting is highly practicable and that the interflection method gives a reasonably close way of predicting the light distribution in rooms, even in cases where there is considerable non-uniformity of reflectances and interference from furniture.

Four offices in Wilson Hall at Brown University were relighted. Inadequate fluorescent lighting had been installed (Fig. 1) and had been found to be thoroughly unsatisfactory. The problem was to design a modern lighting system which would provide a reasonable amount of light for office use, satisfy the 3 to 1 criterion, and give to the ceiling of the offices a finished appearance.

The author is an instructor at Brown University, Providence, R. I.

*Moon and Spencer, *Journal of the Franklin Institute*, 242, 1946, pp. 111, 465.

Figure 1. The original lighting.

According to the conclusions based on the interflection method and modern visual data, some form of ceiling lighting should be used. The question remaining was whether to use hanging luminaires of the luminous-indirect type or a luminous ceiling. The latter was chosen for these offices because of its better aesthetic effect. The panels themselves were constructed from a plasticized paper, which was stretched over wooden frames. Paper panels were used for the sake of economy in the experimental stage of the design and can easily be replaced by more durable plastic panels whenever this change is deemed advisable. The measured reflectance of the plasticized paper was 0.502 and its transmittance was 0.465 at a wavelength of 0.60 micron.

Because of the beamed ceiling and the low ceiling height, it was necessary to use a smaller distance between lamps and diffusing panel than

TABLE I.—Characteristics of Rooms.

	Room A	B	C	D
Height	7′ 2″	7′ 2″	7′ 2″	7′ 4″
Length	19′ 0″	15′ 9″	13′ 8″	16′ 0″
Width	6′ 4″ to 7′ 11″	8′ 9″	8′ 5″	13′ 10″
Domance (Room Index)	0.699	0.672	0.703	0.497
No. lamps (120 ma, 72″ slimline)	16	16	16	24
Lumens (total)	2.54×10^4	2.54×10^4	2.54×10^4	3.82×10^4
Power (watts)	575	575	575	864
Watts per sq. ft.	4.2	4.6	4.9	3.9
Reflectance of wall point	0.600	0.600	0.600	0.600
Av. Reflectance of wall	0.505	0.558	0.554	0.423
Reflectance of floor tile	0.360	0.360	0.436	0.436
Av. Reflectance of floor	0.304	0.330	0.425	0.477

Figure 2. Office *C* with ceiling lighting.

would ordinarily be advisable. This, in turn, required the use of a rather small spacing between lamps to insure reasonable uniformity in the brightness of the ceiling. Slimline lamps were mounted on the ceiling, and the diffusing material was placed approximately six inches below the lamps. The lamp spacing averaged 12 inches between centers of the fluorescent lamps. The lamps were the 72-inch, 4500K white lamps operated at 120 ma. Dimensions and other data on the rooms are listed in Table I.

TABLE II.—Comparison of Calculations and Measurements.

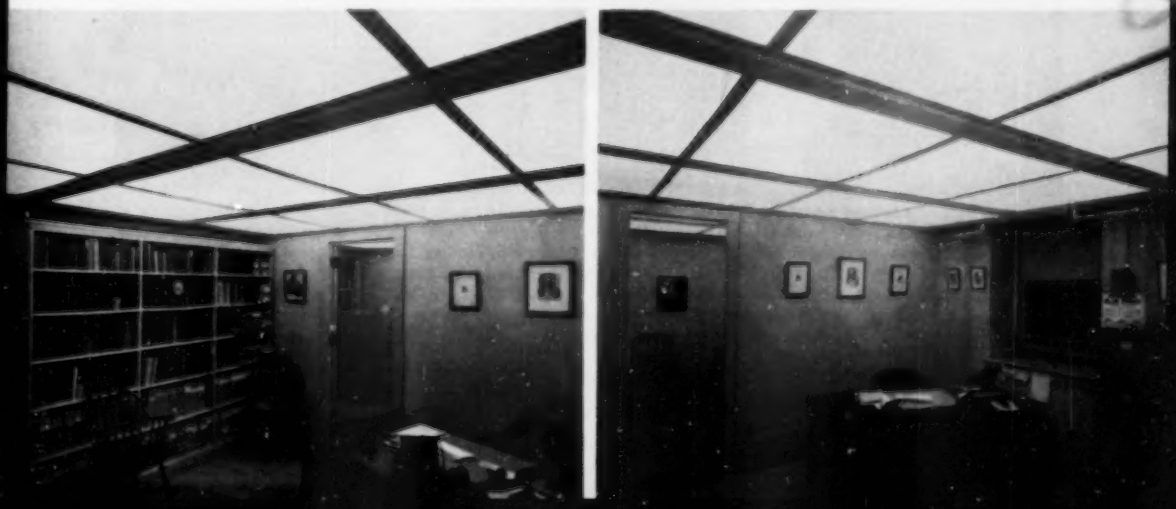
	Calculated	Measured	
		Max.	Min.
Room A			
Illumination (lumen/ft²)	36.4	52.0	22.4
Walls (ft-lamberts)	17.0	12.1	7.6
Panels	124	129	67.5
Floor	9.4	9.3	5.1
Room B			
Illumination	46.0	42.2	35.2
Walls	21.6	20.4	11.2
Panels	132	102	79.0
Floor	13.4	10.0	7.6
Room C			
Illumination	44.2	56.2	22.0
Walls	26.4	14.7	8.9
Panels	154	129	86.0
Floor	20.4	16.0	7.5
Room D			
Illumination	48.7	62.0	30.8
Walls	22.1	11.6	9.4
Panels	132	162	78.8
Floor	17.8	15.1	9.8

Table II gives a comparison of the measurements made six months after installation and calculations using the interflection method.† Average reflectances of room surfaces were computed, weighting the various reflectances with respect to area. A correction was made also for the obstructing framework of the luminous ceiling. Predicted maintenance factor used in the calculations is 0.90 for 6 months operation, based on typical lamp-blackening and dust-collection data.†

Table II shows that calculated values of illumination are in approximate agreement with the measured values. It would seem that these "spot tests" of the interflection method should give added confidence in the use of this new method of predicting the performance of lighting installations. Brightness of walls and floors tends to be somewhat lower than calculated, undoubtedly because of the shielding effect of the furniture, which was neglected in the calculating. Nevertheless, the interflection formulas and tables give a helpful guide to lighting design, even in rooms which do not approximate the empty rooms of the theoretical development.

†Moon and Spencer, *Lighting Design* (Addison-Wesley Press, Cambridge, Mass., 1948).

Figure 3. Two views of office *D* with part of office *C* visible through door.



Public Lighting Aesthetics in Europe

A perfect adaptation to the particular needs, this candelabrum in Budapest is tall but not ungainly. Here a clever design allows for increased height to harmonize with the towering surroundings while the general impression is one of slender beauty.

"Public Lighting and Aesthetics," an illustrated lecture by M. Ludovic Gaymard, was the concluding presentation at the 1949 Conference of the Association of Public Lighting Engineers at Landudno, Wales. Mr. Gaymard, Chief Lighting Engineer for the City of Paris, although he is a technical man, has a keen interest in the aesthetic side of street lighting. He has presented similar lectures at recent technical conferences in Paris and Brussels.

A few of M. Gaymard's excellent illustrations are pictured here, along with a digest of his comments on them.

Adaptation to the urban scenery is the keynote here. The luminaire and its standard should be in harmony with the type of street or place it is intended to illuminate, as is this style candelabrum in the Place Stanslas in Nancy, France.

Sobriety of the contours is important in this day of standardization. This Budapest street lighting unit, although it contains decorative iron work, is simple in design and blends well with any background.

At left, a tubular concrete monotube illustrates how complicated forms have been avoided in the street lighting of Berne, Switzerland. Another point to note here: whenever possible, the color of equipment should match the surrounds. In the center picture, the number of lamp posts along the sidewalk is reduced to a minimum when units are attractively grouped as they are in this six-tube candelabrum in Turin, Italy. However, proper height of the light source must be maintained for good light distribution. At right, a close relationship should exist between the lighting service and the pole positioning. This installation in Paris, where the lighting units are an integral part of the fence, shows careful planning regarding lighting requirements, maintenance, and proper spacing.

The Economic Lighting Limit

By SAMUEL ADAMS BOGEN

Representing the viewpoint of a practicing consulting engineer on the provocative subject of the relationship between lighting and air-conditioning.

THOSE OF us who think of buildings in terms of their lighting alone do not realize how close we are to an economic limit on increasing illumination levels. The belief is widespread that physically and economically the light source may safely be ignored as a heat source, and we find general acceptance of 125 footcandles as the lowest level that gives the average person a perceptible sensation of heat.[1,2,3,4] We as lighting engineers, therefore assume that for most interiors there is no problem of lighting and air-conditioning.[5,6]

But no matter how often we tell the air conditioning engineers how unimportant the lamp is as a heat source, they persist in figuring one watt-hour as equal to 3.415 Btu! And they persist in designing their installations with adequate capacity to remove *all of the heat output* of our interior lighting system! Let us consider what this does to the cost of a building.

If one watt-hour is equal to 3.415 Btu, then a 100-watt lamp produces 341.5 Btu per hour. One ton of air-conditioning is equal (by definition) to 12,000 Btu per hour. Our 100-watt lamp therefore requires $\frac{341.5}{12{,}000}$ ton, or $\frac{1}{35}$ ton of air conditioning to remove its heat output.

If you feel inclined to raise any objections at this point, postpone them for a moment. Some will be discussed later, and in any case, *this is the way our air-conditioning heat loads are actually being calculated today*.

A ton of air-conditioning costs about $800. That is an average price, installed, complete with duct work, grilles, controls, wiring, piping, auxiliary equipment, overhead, profit, etc., for an average commercial installation in the New York area. Sometimes it runs higher, sometimes lower, but $800 a ton is a fair average for our present purpose.

Our 100-watt lamp then requires $\frac{\$800}{35}$, or $23 worth of air-conditioning equipment to remove its heat. This is rather startling, but it is not the whole story by any means.

Each ton of air-conditioning requires between 1.3 and 1.5 horsepower of electric motors to drive compressors, fans and pumps. Let us take 1.4 hp per ton as an average. Assuming an average motor efficiency of 85 per cent, one ton requires 1.4 hp = $\frac{1.4 \times 746}{.85} = 1230$ watts.

One-hundred watts of lighting requires $\frac{1}{35}$ ton of air-conditioning, which requires $\frac{1230}{35}$ or 35 watts of additional electric power. So in addition to the cost of the lighting fixture and air-conditioning equipment, we have added an energy cost and a wiring cost. Neither one of these costs is equal to an additional 35 per cent, as the above calculation might seem to indicate, but they *are not negligible*, and we have been neglecting them too long.

The significance of these considerations in terms of overall cost of buildings is best demonstrated by a consideration of costs per square foot. For example let us take an instance in which we are studying the comparative cost of three lighting levels — 30, 40 and 50 footcandles, in a given air-conditioned interior. We may find that our lighting and wiring costs for these three values are, let us say, $1.50, $1.90 and $2.20 respectively, with watts per square foot of 4, 5.3 and 6.7. What about the relative air-conditioning costs? Let us continue making typical assumptions, and say that the air-conditioning for the 30 footcandle level (4 watts per square foot) is budgeted at $2.50 per square foot. Then at 40 footcandles we have additional 1.3 watts per sq ft, which adds 1.3 × 23c or 30c to the air conditioning, bringing its cost to $2.80 per sq ft. At 50 footcandles we have another 1.4 watts per sq ft, which will add another 32c per sq ft to the cost. Now let us tabulate the figures for this example:

1. Footcandles	30	40	50
2. Watts per sq ft (lighting load only)	4.0	5.3	6.7
3. Cost of lighting and wiring, $ per sq ft	1.50	1.90	2.20
4. Cost of air-conditioning, $ per sq ft	2.50	2.80	3.12
5. Total cost of Nos. 3 and 4	4.00	4.70	5.32

MR. BOGEN is a Consulting Engineer, New York, N. Y.

When we consider that the total cost of air-conditioned buildings today is around $12 to $15 per sq ft, we see that the change from 30 to 50 footcandles may add $1.32 per sq ft, or about 10 per cent to the cost of the air-conditioned part of the building. How long can we continue to ignore this? If we do not want to ignore it, what can we as lighting engineers do about it? Quite a few things.

One thing we can do is include air-conditioning costs in our lighting cost studies, particularly where we are comparing the cost of incandescent and fluorescent lighting designs. Unless we do this, the comparison is meaningless. We must educate our clients to the realization that a cheap incandescent fixture may add more to the cost of the job than a relatively costly fluorescent unit.

Another thing we can do is devote a little more thought to the value of lenses as selective absorbers of radiation. Most lenses transmit light more efficiently than heat. Hence a lens interposed between a recessed lamp and the interior below reduces the radiant as well as the convected heat entering the room below the ceiling. The heat that is prevented from going down, of course, heats the ceiling, the floor slab above and the air space between. If this air space is vented to outside air, a good deal of this heat may be prevented from entering the air-conditioning system. Some effort in this direction has been made by Lewis.[7]

However, it must be remembered that venting the ceiling is almost useless if our lighting system consists of direct incandescent sources. A 150-watt reflector lamp, for example, radiates 80 per cent of its input. Recessing such a lamp in the ceiling, and ventilating the ceiling, cannot possibly remove more than 20 per cent of the lamp's heat output. Eighty per cent of the lamp energy is bound to heat the space below. Worse still, this radiation may reach people before it strikes anything else. If it does so to any great extent, the air conditions required for comfort may be perceptibly changed, and the air-conditioning system may be inadequate to produce comfort even though it is designed to cool the air adequately.

Let me illustrate this point in this way. Suppose we have a store with a 10 ft 6 inch ceiling height. In this ceiling, for purposes of example, let us recess a 250-watt R-40 heat lamp. No one will deny that a customer standing beneath this lamp, with her head some 5 feet away from it, will feel its warmth. Yet if a 300-watt R-40 reflector floodlamp were used in the same position, we would blithely assert that this was an insignificant heat source! We would justify this conclusion by calculating that the footcandle level on the customer's head could not be more than 3000 candlepower divided by 5 feet, squared, or 120 footcandles. With this calculation, and the Luckiesh 125 footcandle criterion, we can prove that a 300-watt R-40 floodlamp five feet from one's head, will not make anyone warm! Obviously the 125 footcandle criterion needs critical re-examination.

Let us now return to methods of heat control. A rather interesting idea was put forth by Cannell, Adams and Forbes[8] in 1939. They developed a paint with a selective reflection factor, 75 per cent for visible radiation and 30 per cent for total radiation. Whether the interior is air-conditioned or not the wide use of a paint of this sort must help in the reduction of reflected heat, while retaining a higher reflection factor for light than most standard wall paints.

Finally, and most important, we can reduce heating effects by keeping before us Darley's[9] excellent table of Approximate Relative Radiant Energy or Heating Effect per Footcandle. The table reads as follows:

Source	Relative Energy per Footcandle
40-w white Type F lamp (53 lumens per watt)	1.00
40-w daylight Type F lamp (45 lumens per watt)	1.25
40-w inside frosted filament lamp (11.7 lumens per watt)	6.6
100-w inside frosted filament lamp (16.2 lumens per watt)	5.7
200-w inside frosted filament lamp (18.4 lumens per watt)	5.1
500-w inside frosted filament lamp (20.0 lumens per watt)	4.5
Sunlight through open window	1.25
Sunlight through ⅛" glass window	1.04
Sky light through ⅛" glass window	0.67
⅛" of ordinary glass interposed between 40-w white Type F lamp and surface on which measurements were made*	0.44

*For filament lamps this would result in about a 20 per cent reduction in heating effect per footcandle.

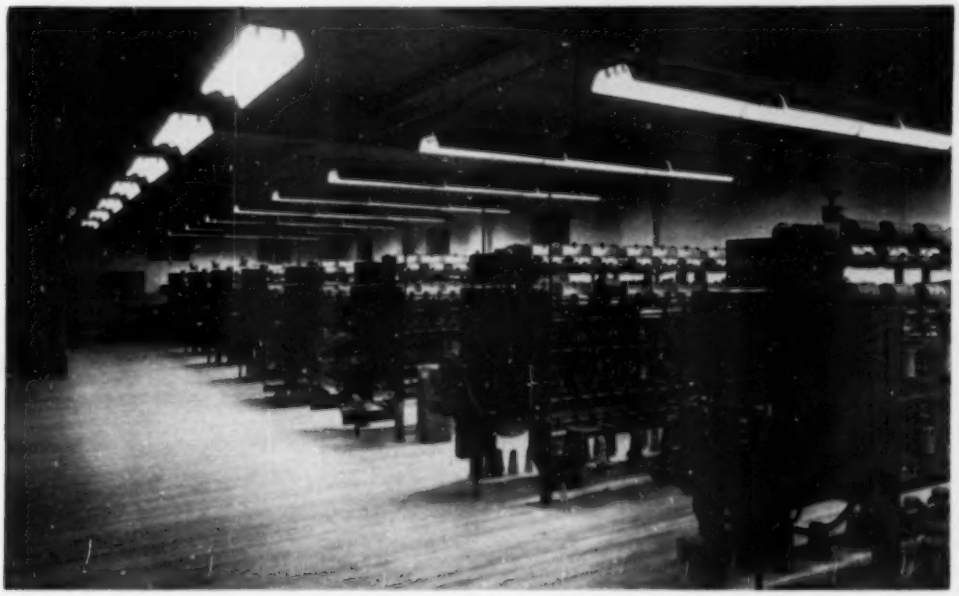
In spite of Darley's apparent assumption that "radiant energy" and "heating effect" are synonymous, or at least directly proportional to each other, this is an extremely valuable table. But let us never forget that the air conditioning designer is going to insist on removing the *total heat*, and not just the radiant energy. Unless we do something to reduce the heat from lighting installations, the economic footcandle limit is in sight.

Bibliography

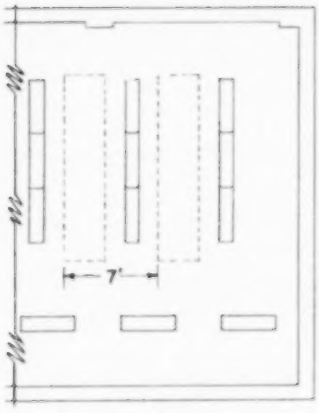
1. Luckiesh, M.: *Magazine of Light*, No. 8 (1938).
2. Moon, Parry and Spencer, Domina Eberle: *Lighting Design*, p. 330.
3. Darley, W. G.: "Cooler Footcandles for Air Conditioning," *Heating, Piping and Air Conditioning*, (August, 1940).
4. *IES Lighting Handbook*, Section 10, Illuminating Engineering Society (1947).
5. Sharp, H. M.: "Lighting and Air Conditioning," *Lighting and Lamps* (June, 1946).
6. Committee on Lighting and Air Conditioning of the Illuminating Engineering Society: "Lighting and Air Conditioning Design Factors," ILLUMINATING ENGINEERING, Vol. XXXVI, p. 853 (September, 1941).
7. Lewis, S. R.: "Lighting, Air Conditioning and Air Cleaning," ILLUMINATING ENGINEERING, Vol. XL, p. 37 (January, 1945).
8. Cannell, D., Adams, E. Q., and Forbes, J. C.: "A New Means of Minimizing Radiant Heat from Lighting Systems," ILLUMINATING ENGINEERING, Vol. XXXIV, p. 726 (July, 1939).
9. Darley, W. G.: "Cooler Footcandles for Air Conditioning," *Heating, Piping and Air Conditioning* (August, 1940).

Lighting for Twisting Elastic Yarn

LIGHTING OBJECTIVE: To provide the high level of illumination required for the twisting operation in elastic yarn manufacture.



Installation at Fergus Perry, 5013 Wakefield Street, Philadelphia, Pa. Lighting designed by D. M. Hoffman, Philadelphia Electric Company, and installed by A. Roland Yerkes, Philadelphia.



Plan View.

General Information: The twisting of elastic yarns of the type used in the two-way stretch girdles, etc., involves viewing fine detail which is constantly in motion. The operators inspect for breaks in the thread and tie threads if a break occurs. They must also replace empty spools with full ones.

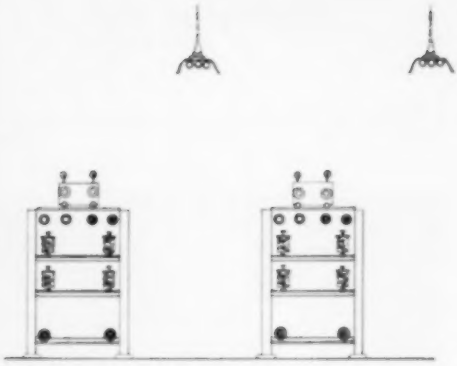
Reflection factors of the 66½ x 27 x 11 foot area shown above are as follows:

Cream Walls and Ceiling	65 per cent
Light Maple Floor	26 per cent

Installation: General illumination is provided by 27 Sylvania HF-150 fluorescent luminaires each containing three 40-watt 3500K fluorescent lamps. These are mounted on 7-foot centers 8 feet above the floor (between the rows of machines). The aisle at the left is lighted by 9 Sylvania HF-100 two-lamp luminaires.

(over)

A.I.A. File No. 31/13



Sketch showing relation of machines and lighting units.

Average illumination at the machines on a horizontal plane 30 inches above the floor is 100 footcandles. Vertical illumination at 12-inch intervals 3½ feet above the floor measured 58, 60, 60, 62, 62, 62, 60, 61, 58, 58, 57 footcandles with a General Electric Model 8DW40YZ light meter.

Brightness readings are as follows:

Northeast Wall		
Upper	9	footlamberts
Middle	18	"
Southwest Wall		
Upper	11	"
Middle	13	"
Floor		
Between Machines	12	"
Traffic Area	11	"
Ceiling	9	"
Luminaires		
Normal to Reflector	1100	"
45° to Reflector	1150	"

Lighting data submitted by George T. Anderson, Jr., Philadelphia Electric Company as an illustration of good lighting practice and to aid in the design of similar installations.

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Munsell Reference Colors Now Specified for Nine Illuminants

By DOROTHY NICKERSON
DAVIS H. WILSON

THE GROWING interest of the illuminating engineer in color as an essential element in the illuminated environment makes it advisable to provide him with as much engineering data on color as he can use.

One useful set of reference data is that supplied for the restricted selections of about 450 Munsell standards measured spectrophotometrically at the National Bureau of Standards several years ago. Tristimulus specifications for what the I.C.I. observer would see were published in 1943 for four illuminants by Kelly, Gibson, Nickerson.[1] The illuminants involved were I.C.I. *A* and *C*, Macbeth 7500K (designated illuminant "*D*"), and an illuminant designed as the blue end point for a series ranging from fully overcast to maximally clear sky (designated illuminant "*S*"—for Sky). Computations for Illuminant *C*, representative of average daylight, were of primary interest, and the computations for Illuminant *C* were carried out both at the National Bureau of Standards and the United States Department of Agriculture. Those for *C* and the other illuminants were made in the Department of Agriculture by use of I.B.M. equipment, automatically punching sums obtained by the method of progressive digiting, using the weighted ordinate method of calculation at 10 millimicron intervals, wavelengths 380 to 770.[2] A summary of these data was published in ILLUMINATING ENGINEERING, 1945.[3]

About two years ago, C. L. Crouch, I.E.S. Technical Director, enlisted the advice of Deane B. Judd, Ralph M. Evans, and Dorothy Nickerson regarding a program of research that might be conducted in the field of color and illumination. One suggestion was that Munsell reference data be extended to include additional illuminants, fluorescent illuminants in particular. Such information would provide data necessary for any final determination of formulas for predicting changes of hue, lightness, and saturation of object colors under various illuminants.[4][5] The original data of the National Bureau of Standards, plus those for the 9/ value colors used in the special Munsell value scales prepared to aid illuminating engineers in judging reflectance,[6] and for other 9/ and 9.25/ value samples measured in the laboratories of the Interchemical Corporation by W. C. Granville,[7] were therefore set up for calculation on I.B.M. equipment.

Since the method of calculation permits as much data to be punched at one time as the 80 columns on each card allow, it was possible to use five illuminants. These included I.C.I. "*B*," which had been requested by the British some time ago, and four fluorescent illuminants, "3500K" and "4500K white," "6500K daylight," and "soft white."

The computational data used for the four fluorescent illuminants are given in Table I. These are based on energy data requested in 1947 through I.E.S. headquarters and supplied in 1948 by Dr. P. T. Barnes and Mr. E. S. Steeb, Jr. of the General Electric Laboratories at Nela Park. The calculated results were checked at Nela Park against colorimetric readings on their regular production of lamps to be sure that the data used would be representative of current production. Since changes in production may be expected whenever it is possible to improve these lamps, the Nela Park laboratories were kind enough to select and supply half a dozen representative 3500K, 4500K, and 6500K lamps in 40-watt size. At the time that these lamp selections were made,[8] the soft white as measured was out of production. The selected lamps are available for experimental studies involving the correlation of observed and calculated color data in which these illuminants are a factor.

Fig. 1 provides curves of relative energy for the nine illuminants for which data on the series of Munsell reference materials are now available.

The *X*, *Y*, *Z* data listed in Table II represent what the I.C.I. Standard Observer should see when he looks at these Munsell papers under I.C.I. *B* illuminant and under fluorescent lamps 3500K, 4500K, 6500K, and soft white of energy distributions similar to the lamps for which computations are given in this paper.

One suggestion or word of caution should be made in connection with the use of these data. Spectral reflectance data for most of the Munsell samples follow a fairly smooth distribution.[4] If samples compared with them under one illumination make good matches, there is no guarantee that such samples will continue to match them under another illuminant. Many agricultural products have definite absorption bands, for example, the familiar chlorophyll bands of green vegetation, or the haemoglobin bands in red beef. In

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MISS NICKERSON is a Color Technologist with the Research and Testing Division, Cotton Branch, PMA, U. S. Department of Agriculture. MR. WILSON is Chief, Machine Operations Section, PMA.

[1]Circled numbers refer to List of References.

[2]The general statistical method is described by Knudson[7]. A description of its specific application to colorimetric calculation such as used in this and previous studies has been published by D. L. MacAdam: Optical Soc. Amer. Jour. 40: 138-140 (1950).

[8]Since this manuscript was submitted for publication a further change has been made. The zinc-beryllium silicate phosphor was abandoned in 1949, being replaced by the halo phosphate phosphor, with a consequent loss in the red emission. However, a new line of de luxe lamps announced in late 1949 is designed to overcome the deficiency in the red end of the spectrum.

[9]Tables of the spectral reflectance data on which the calculations in Table II are based cover 58 closely typed pages. It seems needless to publish such extensive data, yet for some experimental or check use they are necessary. Copies are on file in several places and can be obtained when needed for experimental or theoretical use by writing the authors.

Table I.—Computational data for I.C.I. "B illuminant" and four fluorescent illuminants designated as 3500K, 4500K, and soft white. I.C.I. Tristimulus values X, Y, Z (Y=100,000)

Wave Length 10 mu. Intervals	I.C.I B			Fluorescent 3500K			Fluorescent 4500K			Fluorescent 6500K			Fluorescent Soft White		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
380	3		14	1		3	1		4	2		10			4
390	13		60	3		13	4		22	1		42	5		23
400	56	2	280	15		71	23		111	41	1	191	26		124
410	217	6	1,033	57	2	272	101	3	481	162	4	773	108	3	514
420	812	24	3,899	230	7	1,105	411	13	1,974	640	19	3,075	438	13	2,105
430	1,983	61	9,678	621	26	3,032	1,093	44	5,333	1,740	71	8,493	1,148	47	5,601
440	2,689	178	13,489	911	60	4,571	1,598	105	8,015	2,553	169	12,808	1,726	113	8,657
450	2,744	310	14,462	995	112	5,243	1,773	200	9,344	2,771	313	14,606	1,973	223	10,398
460	2,424	506	14,085	927	191	5,320	1,681	347	9,646	2,626	542	15,072	1,858	383	10,665
470	1,718	800	11,319	653	303	4,299	1,191	555	7,848	1,853	863	12,213	1,325	617	8,731
480	870	1,265	7,396	327	476	2,764	594	864	5,050	919	1,335	7,812	655	952	5,565
490	298	1,918	4,280	114	740	1,655	198	1,290	2,884	307	1,999	4,470	213	1,384	3,094
500	44	2,908	2,449	19	1,229	1,035	31	2,037	1,716	46	3,050	2,569	31	2,064	1,738
510	81	4,360	1,371	41	2,225	700	62	3,342	1,051	85	4,604	1,448	59	3,182	1,000
520	541	6,072	669	359	4,018	442	460	5,159	568	563	6,322	697	400	4,491	494
530	1,488	7,594	372	1,181	6,150	301	1,344	6,999	343	1,446	7,533	389	1,058	5,508	270
540	2,689	8,634	188	2,362	7,760	166	2,467	8,169	174	2,466	8,100	172	1,893	6,220	133
550	4,183	9,603	84	3,835	8,803	77	3,799	8,719	76	3,608	8,285	72	2,995	6,877	60
560	5,840	9,774	38	5,655	9,465	37	5,379	9,003	35	4,925	8,242	32	4,264	7,136	27
570	7,472	9,334	21	7,684	9,599	21	7,258	9,066	20	6,313	7,887	17	6,062	7,572	17
580	8,843	8,396	16	10,024	9,518	19	9,276	8,808	17	7,856	7,459	15	8,364	7,941	16
590	9,728	7,176	10	11,960	8,821	12	10,737	7,919	12	9,096	6,710	10	10,974	8,094	12
600	9,948	5,909	7	12,328	7,323	10	11,202	6,655	8	9,415	5,593	7	13,159	7,816	10
610	9,436	4,734	3	11,445	5,742	4	10,235	5,135	3	8,679	4,354	2	13,074	6,559	4
620	8,140	3,630	2	9,185	4,095	2	8,037	3,585	2	7,007	3,125	2	10,695	4,770	3
630	6,200	2,558		6,050	2,496		5,433	2,241		4,790	1,976		7,540	3,110	
640	4,374	1,709		3,579	1,398		3,283	1,282		2,931	1,145		4,672	1,826	
650	2,815	1,082		1,915	723		1,711	645		1,597	603		2,514	949	
660	1,655	612		909	337		786	291		779	288		1,183	438	
670	876	321		379	139		325	119		336	123		490	180	
680	445	160		160	58		133	49		145	53		214	78	
690	230	80		61	22		47	17		56	20		83	30	
700	108	39		22	8		17	6		21	7		31	12	
710	53	19		6	2		6	2		7	2		12	4	
720	26	9		2			2			1			4	1	
730	12	4													
740	6	2													
750	2	1													
760	2	1													
770	1														
Addition at Mercury Lines															
405				106	3	503	102	3	488	135	3	640	151	4	718
436				3,763	204	18,641	4,340	235	21,499	4,719	256	23,380	5,722	310	28,343
546				2,313	6,084	76	2,090	5,500	69	2,677	7,044	88	3,512	9,239	116
578				1,858	1,861	4	1,591	1,593	3	1,897	1,900	3	1,852	1,854	4
Sums	99,072	100,000	85,223	102,055	100,000	50,418	98,841	100,000	76,796	95,211	100,000	109,088	110,483	100,000	88,446
x, y, z	3485	3518	2998	4042	3961	1997	3586	3628	2786	3129	3286	3585	3696	3343	2959

many industries there must be similar problems. Thus, while samples with smooth curves are best for general use as reference materials, it is suggested that recourse be made more and more often to the use of "light boxes" in which the several illuminants of interest may be set up. This can be done in very simple fashion. The reference material can then be viewed and compared under the illuminant in which it is to be used. If a chair that is to be upholstered is to be used under a fluorescent illuminant, the choice of upholstery color can be made by use of reference material selected under that illuminant. But the color of any fabric purchased at the store to match this reference sample should also be checked under the type of fluorescent illuminant in which it is to be used since a match under daylight does not guarantee that this match will hold under fluorescent or any other illuminant in which the energy distribution differs from that of daylight. Another example of the importance of checking a color match in a required illuminant can be cited from agricultural experience. Color scales made for daylight inspection of meat may be totally inadequate if used in the incandescent light of the cooler in which meats are stored. The reference material used in establishing such scales should be matched with the meat under the illuminant in which the reference scales are to be used. This is because the meat color, which has spectral absorption bands not present in the reference material, does not change in the same way that the reference standards change.

The colorimetric data provided here and in previous papers, add to engineering information on color by providing measurements on a standard set of color reference materials that, on the one hand, can be calculated for use under any of the illuminants studied (or interpolated for illuminants between these), or, on the other hand, can be checked and used with visual observation. The Y data supply "per cent reflectance" for a given sample under the particular illuminant to which it is referred. Such data provide the link that is necessary for any final or accurate prediction of change in color of an object under change of illumination.

For an introduction to a general understanding of the subject of color two recent books are recommended, both excellent. One is by Evans[7] written from the point of view of the scientist; the other by Pope is written from the artist's point of view.[8] One of the many reasons for using the Munsell system of color notation in work of this sort is discussed in a recent paper by Burnham[9] and applied in a recent paper by Nickerson.[10] A summary of the report of the O.S.A. Sub-committee on the Spacing of the Munsell Colors[6] appeared in this journal in 1945.[11]

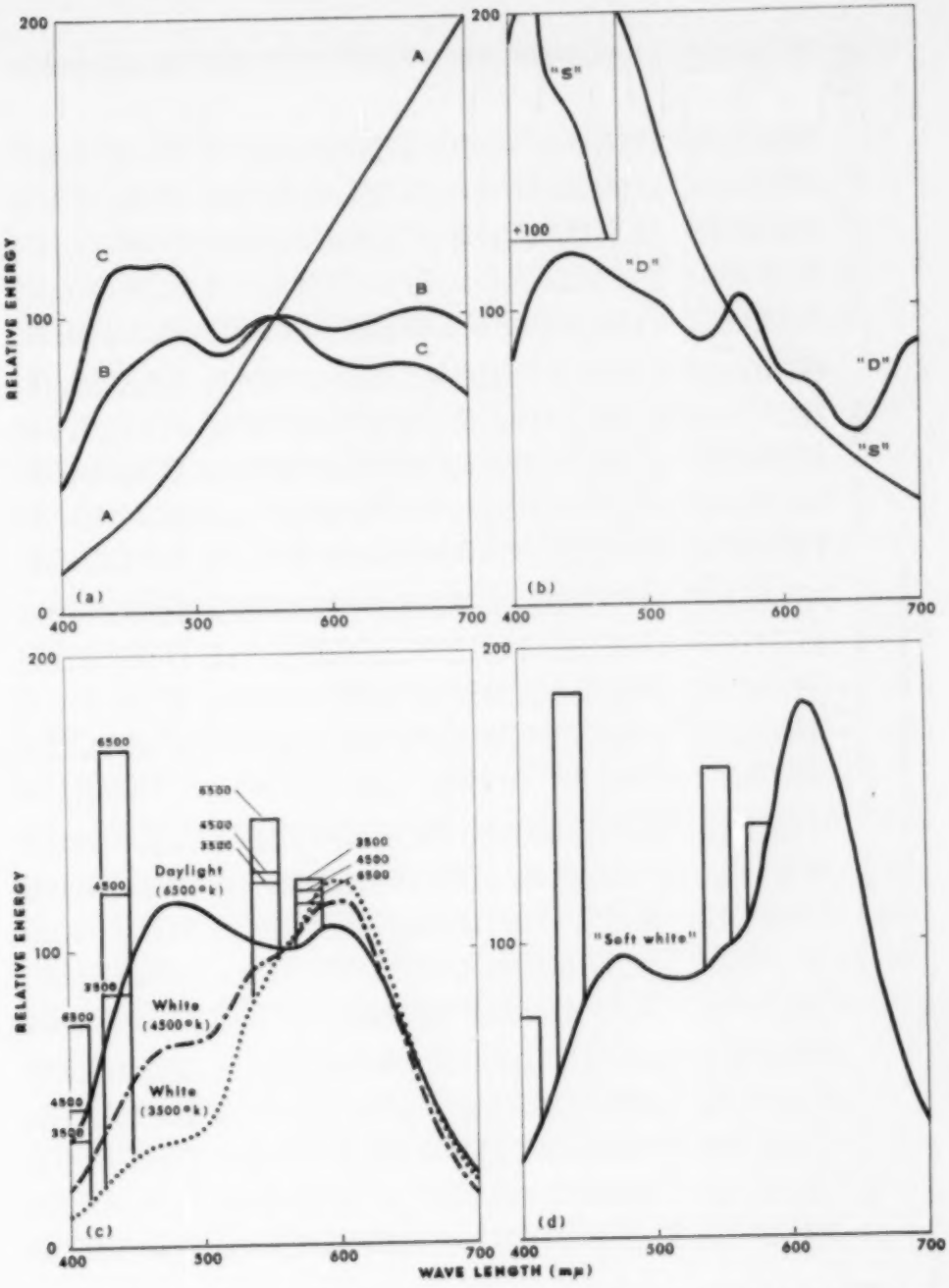


Figure 1. Relative spectral energy distributions, reduced to 100 at 560 mμ, for nine illuminants used to obtain I.C.I. specifications for standard Munsell reference materials: (a) I.C.I. illuminants A, B, and C. (b) Illuminant "D" (Macbeth 7500K) and "S" (theoretical limit blue sky). (c) Fluorescent illuminants: 3500K, 4500K, 6500K. (d) Fluorescent "soft-white."

TABLE II.—Tristimulus values and chromaticity coordinates of selected Munsell standards for five illuminants, in addition to four published J.O.S.A. July 1943, based on spectrophotometric data.

Munsell notation	ICI B Illuminant					Fluorescent 3500K					Fluorescent 4500K					Fluorescent 6500K					Fluorescent Soft White					Munsell painting number
	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	
N 9/6	.8973	.9079	.7555	.3504	.3546	.9256	.9085	.4459	.4080	.3985	.8953	.9082	.6797	.3805	.3637	.8809	.9078	.9859	.3148	.3330	1.0006	.9063	.7834	.3718	.3375	60
N 9/4	.8231	.8318	.6832	.3521	.3558	.8495	.8329	.4024	.4075	.3995	.8209	.8371	.6139	.3621	.3671	.7884	.8312	.8728	.3163	.3335	.9177	.8324	.7064	.3728	.3389	1486
N 9/	.7186	.7259	.6045	.3507	.3543	.7408	.7261	.3580	.4064	.3983	.7164	.7258	.5432	.3806	.3656	.6886	.7255	.7721	.3150	.3318	.8011	.7261	.6251	.3722	.3374	1177
N 8/	.5669	.5754	.4688	.3519	.3571	.5854	.5780	.2751	.4075	.4010	.5656	.5756	.4200	.3622	.3687	.5430	.5752	.5976	.3165	.3352	.6318	.5756	.4831	.3737	.3405	1176
N 7/	.4379	.4432	.3813	.3489	.3510	.4510	.4431	.2256	.4028	.3957	.4372	.4433	.3437	.3572	.3621	.4216	.4434	.4882	.3115	.3277	.4883	.4429	.3969	.3680	.3338	1175
N 6/	.3092	.3032	.2582	.3484	.3519	.3096	.3036	.1527	.4042	.3964	.2999	.3035	.2327	.3587	.3630	.2888	.3033	.3305	.3131	.3287	.3349	.3033	.2680	.3696	.3347	1071
N 5/	.1888	.1906	.1652	.3467	.3499	.1944	.1908	.0979	.4024	.3949	.1885	.1907	.1491	.3568	.3610	.1819	.1907	.2117	.3113	.3284	.2105	.1906	.1718	.3675	.3327	897
N 4/	.1198	.1208	.1054	.3463	.3492	.1234	.1212	.0627	.4016	.3943	.1198	.1212	.0954	.3561	.3603	.1156	.1212	.1354	.3107	.3257	.1338	.1212	.1100	.3686	.3321	1070
N 3/	.0649	.0651	.0571	.3469	.3479	.0667	.0651	.0339	.4025	.3927	.0647	.0650	.0516	.3568	.3587	.0624	.0650	.0732	.3111	.3241	.0724	.0651	.0595	.3675	.3305	1171
N 2/	.0300	.0300	.0263	.3477	.3475	.0309	.0300	.0158	.4027	.3918	.0299	.0300	.0239	.3569	.3579	.0289	.0300	.0339	.3115	.3232	.0335	.0300	.0276	.3677	.3296	1068
N 1/	.0152	.0154	.0134	.3459	.3497	.0156	.0153	.0080	.4009	.3942	.0151	.0154	.0121	.3552	.3606	.0146	.0154	.0172	.3098	.3263	.0169	.0154	.0139	.3663	.3322	1169
5R 9/3	.7467	.7169	.5775	.3658	.3512	.7722	.7232	.3433	.4199	.3933	.7424	.7179	.5222	.3745	.3621	.7085	.7116	.7411	.3278	.3283	.8374	.7249	.6019	.3889	.3350	2237°
2	.7408	.7234	.5949	.3598	.3513	.7646	.7272	.3525	.4146	.3943	.7369	.7238	.5368	.3689	.3624	.7056	.7198	.7622	.3225	.3290	.8290	.7286	.6184	.3810	.3348	2236°
8/4	.6452	.5936	.4512	.3818	.3512	.6701	.6037	.2892	.4343	.3913	.6401	.5952	.4090	.3893	.3620	.6058	.5849	.5802	.3421	.3303	.7266	.6059	.4717	.4027	.3358	1148
2	.6329	.6062	.4896	.3661	.3507	.6552	.6123	.2910	.4204	.3929	.6299	.6073	.4427	.3750	.3615	.6009	.6012	.6394	.3283	.3294	.7095	.6129	.5103	.3872	.3344	342
7/8	.5433	.4378	.2829	.4298	.3464	.5671	.4529	.1702	.4765	.3805	.5331	.4385	.2579	.4336	.3566	.4941	.4210	.3652	.3859	.3288	.6201	.4601	.2978	.4500	.3339	94
6	.5408	.4564	.3080	.4144	.3497	.5636	.4693	.1842	.4631	.3856	.5323	.4572	.2796	.4194	.3603	.4963	.4425	.3964	.3717	.3314	.6143	.4746	.3225	.4352	.3383	880
4	.5235	.4499	.3200	.4047	.3478	.5454	.4617	.1919	.4549	.3851	.5169	.4510	.2911	.4106	.3582	.4841	.4379	.4125	.3537	.3281	.5936	.4657	.3360	.4254	.3336	93
2	.4888	.4567	.3576	.3751	.3505	.5069	.4633	.2131	.4284	.3915	.4856	.4578	.3239	.3832	.3612	.4612	.4511	.4596	.3362	.3288	.5494	.4643	.3735	.3981	.3347	80
6/10	.4716	.3398	.1803	.4752	.3429	.4916	.3555	.1097	.5138	.3716	.4564	.3389	.1656	.4750	.3527	.4164	.3191	.2340	.4295	.3291	.5430	.3668	.1915	.4931	.3330	1156
8	.4425	.3369	.1951	.4541	.3457	.4619	.3506	.1178	.4965	.3769	.4311	.3367	.1783	.4557	.3559	.3980	.3199	.2523	.4090	.3304	.5072	.3586	.2060	.4732	.3346	338
6	.4238	.3414	.2192	.4305	.3468	.4417	.3533	.1325	.4762	.3809	.4152	.3418	.2004	.4336	.3570	.3850	.3279	.2836	.3983	.3291	.4828	.3582	.2316	.4500	.3340	728
4	.3956	.3391	.2320	.4092	.3508	.4132	.3496	.1398	.4578	.3873	.3910	.3406	.2116	.4145	.3611	.3653	.3294	.2997	.3873	.3314	.4482	.3514	.2444	.4293	.3386	726
2	.3492	.3241	.2486	.3784	.3512	.3624	.3291	.1487	.4313	.3917	.3467	.3249	.2261	.3882	.3619	.3286	.3197	.3208	.3391	.3299	.3929	.3300	.2806	.3964	.3356	332
5/12	.3508	.2102	.0714	.5547	.3325	.3585	.2192	.0435	.5771	.3529	.3271	.2043	.0656	.5479	.3422	.2928	.1871	.0926	.5114	.3268	.4067	.2384	.0759	.5464	.3279	894
10	.3556	.2280	.0926	.5259	.3371	.3657	.2378	.0563	.5543	.3604	.3356	.2235	.0850	.5210	.3471	.3024	.2070	.1201	.4804	.3289	.4114	.2516	.0982	.5405	.3305	729
8	.3175	.2093	.0944	.5111	.3369	.3294	.2195	.0570	.5437	.3623	.3033	.2069	.0863	.5084	.3469	.2739	.1921	.1221	.4657	.3266	.3680	.2305	.0997	.5271	.3301	18
6	.2953	.2102	.1130	.4775	.3398	.3085	.2201	.0682	.5169	.3688	.2843	.2096	.1032	.4778	.3499	.2609	.1949	.1462	.4320	.3280	.3412	.2277	.1194	.4957	.3309	16
4	.2524	.1983	.1234	.4397	.3454	.2641	.2061	.0738	.4855	.3788	.2475	.1987	.1121	.4433	.3559	.2284	.1866	.1589	.3958	.3289	.2890	.2099	.1294	.4800	.3341	14
2	.2236	.1988	.1470	.3927	.3491	.2328	.2033	.0875	.4446	.3883	.2215	.1994	.1331	.3998	.3599	.2085	.1947	.1889	.3522	.3288	.2526	.2043	.1525	.4138	.3348	12
4/14	.2664	.1469	.0395	.5884	.3244	.2870	.1509	.0240	.6042	.3415	.2421	.1394	.0363	.5795	.3337	.2158	.1268	.0512	.5480	.3219	.3063	.1665	.0419	.5967	.3222	42R
14	.2666	.1470	.0404	.5873	.3237	.2847	.1499	.0245	.6029	.3413	.2402	.1386	.0370	.5776	.3334	.2146	.1263	.0523	.5457	.3212	.3065	.1654	.0428	.5955	.3213	1181
12	.2633	.1489	.0454	.5755	.3254	.2639	.1528	.0273	.5946	.3439	.2399	.1417	.0414	.5672	.3350	.2145	.1296	.0585	.5327	.3219	.3044	.1676	.0478	.5856	.3226	40
10	.2359	.1410	.0548	.5466	.3286	.2349	.1433	.0329	.5715	.3485	.2148	.1344	.0468	.5384	.3368	.1937	.1246	.0706	.4981	.3204	.2700	.1555	.0575	.5580	.3230	730
8	.2208	.1401	.0596	.5251	.3330	.2274	.1460	.0359	.5556	.3546	.2087	.1372	.0544	.5213	.3428	.1880	.1271	.0771	.4794	.3241	.2546	.1583	.0629	.5404	.3271	39R
6	.1877	.1315	.0686	.4842	.3391	.1958	.1377	.0413	.5223	.3675	.1814	.1309	.0625	.4839	.3492	.1650	.1227	.0886	.4385	.3261	.2170	.1430	.0723	.5021	.3307	36R
4	.1656	.1282	.0801	.4429	.3429	.1730	.1332	.0484	.4879	.3757	.1620	.1283	.0732	.4457	.3529	.1495	.1223	.1037	.3981	.3253	.1898	.1360	.0846	.4634	.3313	34
2	.1491	.1305	.0935	.3996	.3498	.1553	.1339	.0559	.4502	.3880	.1474	.1310	.0949	.4058	.3605	.1384	.1275	.1204	.3583	.3300	.1696	.1347	.0979	.4303	.3384	32
3/10	.1343	.0805	.0368	.5468	.3277	.1338	.0822	.0191	.5691	.3497	.1234	.0769	.0287	.5368	.3375	.1105	.0712	.0404	.4975	.3305	.1534	.0886	.0332	.5572	.3221	732
8	.1262	.0798	.0347	.5247	.3311	.1270	.0817	.0210	.5529	.3555	.1167	.0769	.0318	.5177	.3413	.1057	.0716	.0449	.4755	.3223	.1444	.0871	.0368	.5383	.3246	731
6	.1230	.0877	.0458	.4913	.3342	.1318	.0906	.0280	.5284	.3619	.1220	.0881	.0422	.4874	.3441	.1113	.0810	.0596	.4419	.3215	.1481	.0950	.0488	.5072	.3255	738
4	.1052	.0768	.0431	.4673	.3414	.1088	.0795	.0261	.5075	.3708	.1012	.0762	.0394	.4668	.3513	.0927	.0723	.0558	.4200	.3273	.1209	.0824	.0456	.4858	.3310	314
2	.0862	.0732	.0520	.4076	.3483	.0895	.0749	.0309	.4582	.3836	.0847	.0732	.0470	.4134	.3572	.0792	.0711	.0667	.3650	.3275	.0979	.0760	.0542	.4292	.3331	312
2/6	.0702	.0485	.0309	.4693	.3241	.0716	.0500	.0194	.5077	.3548	.0667	.0477	.0290	.4652	.3325	.0615	.0451	.0408	.4172	.3058	.0806	.0522	.0337	.4839	.3135	1124
4	.0552	.0402	.0257	.4559	.3318	.0583	.0413	.0158	.4972	.3635	.0528	.0397	.0238	.4543	.3410	.0488	.0378	.0336	.4062	.3143	.0632	.0428	.0276	.4729	.3205	860
2	.0501	.0411	.0300	.4133	.3390	.0516	.0421	.0184	.4604	.3758	.0489	.0410	.0277	.4156	.3487	.0458	.0397	.0391	.3676	.3186	.0569	.0428	.0321	.4317	.3249	322
10R 8/4	.6789	.6217	.4140	.3980	.3626	.7107	.6390	.2472	.4451	.4002	.6747	.6261	.3752	.4028	.3736	.6330	.6105	.5320	.3565	.3438	.7638	.6371	.4325	.4166	.3473	722
7/8	.5529	.4458	.1999	.4613	.3719	.5855	.4696	.1207	.4980	.3994	.5445	.4504	.1823	.4636	.3836	.4968	.4388	.2578	.4205	.3613	.6308	.4719	.2102	.4805	.3594	682
6	.5512	.4682	.2616	.4303	.3655	.5805	.4888	.1573	.4733	.3985	.5450	.4727	.2382	.4340	.3764	.5037	.4530	.3372	.3893	.3501	.6241	.4882	.2748	.4499	.3520	714
4	.5315	.4644	.2877	.4141	.3618	.5577	.4812	.1725	.4603	.3972	.5264	.4681	.2616	.4191	.3727	.4901	.4522	.3706	.3733	.3444	.6005	.4809	.3018	.4342	.3477	667
6/10	.4657	.3430	.0958	.5143	.3788	.4981	.3705	.0589	.5370	.3995	.4573	.3484	.0886	.5113	.3896	.4095	.3213	.1251	.4785	.3754	.5339	.3719	.1022	.5297	.3689	383
8	.4499	.3502	.1316	.4829	.3759	.4796	.3743	.0799	.5136	.4008	.4436	.3555	.1205	.4824	.3895	.4014	.3324	.1702	.4440	.3677	.5138	.3744	.1391	.5002	.3645	585
6	.4294	.3509	.1628	.4553	.3721	.4548	.3701	.0979	.4928	.4011	.4236	.3550	.1481	.4571	.3831	.3873	.3367	.2096	.4149	.3606	.4880	.3701	.1708	.4743	.3597	733
4	.3844	.3344	.1973	.4196	.3651	.4051	.3485	.1191	.4642	.3993	.3817	.3381	.1801	.4241	.3757	.3542	.3253	.2548	.3791	.3481	.4346	.3472	.2079	.4392	.3508	587
5/10	.3052	.2109	.0491	.5400	.3732	.3216	.2253	.0296	.5578	.3908	.2936	.2112	.0447	.5343	.3844	.2618	.1944	.0631	.5041	.3744	.3514	.2312	.0514	.5543	.3647	390
8	.3148	.2301	.0680	.5137	.3754	.3358	.2477	.0410	.5376	.3998	.3083	.2330	.0620	.5110	.3863	.2763	.2151	.0876	.4772	.3716	.3612	.2495	.0714	.5295	.3688	734
6	.2869	.2177	.0814	.4898	.3715	.3048	.2320	.0492	.5202	.3959	.2815	.2201	.0743	.4888	.3822	.2547	.2055	.1050	.4522	.3638	.3385	.2337	.0857	.5071	.3607	585
4	.2580	.2100	.1067	.4470	.3666	.2711	.2213	.0643	.4870	.3978	.2533	.2126	.0973	.4498	.3775	.2334	.2018	.1376	.4064	.3529	.2910	.2211	.1122	.4661	.3542	580
4/10	.2345	.1595	.0412	.5386	.3668	.2492	.1721	.0248	.5586	.3858	.2277	.1608	.0375	.5345	.3775	.2023	.1511	.0530	.5033	.3651	.2716	.1764	.0432	.5529	.3591	761

8	.2186	.1521	.0419	.5298	.3687	.2319	.1635	.0249	.5518	.3890	.2122	.1532	.0378	.5364	.3799	.1395	.1407	.0635	.4939	.3666	.2519	.1867	.0434	.5482	.3629	747
6	.2070	.1505	.0500	.5079	.3694	.2192	.1607	.0298	.5350	.3923	.2016	.1517	.0452	.5060	.3807	.1812	.1406	.0640	.4696	.3645	.2374	.1630	.0520	.5248	.3603	735
4	.1755	.1401	.0646	.4615	.3686	.1854	.1476	.0387	.4988	.3970	.1725	.1414	.0587	.4630	.3795	.1574	.1339	.0831	.4205	.3576	.2000	.1484	.0676	.4808	.3543	991
3/6	.1138	.0829	.0321	.4975	.3622	.1202	.0880	.0195	.5281	.3864	.1108	.0833	.0294	.4960	.3726	.1001	.0776	.0415	.4585	.3541	.1310	.0897	.0339	.5146	.3522	736
4	.1006	.0774	.0362	.4696	.3613	.1060	.0813	.0216	.5075	.3892	.0984	.0778	.0327	.4710	.3722	.0396	.0735	.0464	.4277	.3507	.1154	.0836	.0377	.4894	.3506	595
2/2	.0584	.0472	.0267	.4348	.3516	.0605	.0486	.0172	.4789	.3848	.0568	.0471	.0261	.4368	.3622	.0526	.0453	.0370	.3900	.3358	.0663	.0494	.0301	.4547	.3368	915
5 YR. 9/3	.7745	.7419	.4857	.3898	.3706	.8111	.7804	.2877	.4363	.4090	.7720	.7482	.4378	.3943	.3821	.7367	.7336	.6214	.3491	.3524	.8074	.7550	.5038	.4080	.3851	2431
2	.8014	.7767	.5654	.3739	.3623	.8336	.7866	.3325	.4289	.4028	.7975	.7792	.5072	.3827	.3739	.7580	.7703	.7210	.3364	.3428	.8977	.7861	.5833	.3960	.3467	old std.
8/4	.6503	.6086	.3804	.3972	.3705	.6823	.6237	.2285	.4452	.4070	.6470	.6115	.3440	.4038	.3816	.6060	.5966	.4878	.3385	.3529	.7299	.6200	.3960	.4181	.3551	389
2	.6170	.5966	.4361	.3740	.3616	.6413	.6046	.2579	.4265	.4020	.6138	.5986	.3927	.3824	.3729	.5821	.5913	.5578	.3363	.3416	.6906	.6035	.4520	.3905	.3486	384
7/10	.5380	.4373	.0955	.5024	.4084	.5798	.4698	.0569	.5240	.4246	.5325	.4480	.0857	.5004	.4191	.4768	.4167	.1211	.4699	.4107	.6122	.4557	.0978	.5207	.3961	867
8	.5452	.4529	.1460	.4765	.3959	.5843	.4820	.0842	.5079	.4189	.5401	.4804	.1288	.4782	.4077	.4878	.4339	.1834	.4414	.3926	.6184	.4783	.1472	.4971	.3845	740
6	.5013	.4309	.1908	.4464	.3837	.5321	.4511	.1134	.4852	.4114	.4961	.4356	.1720	.4495	.3946	.4540	.4166	.2438	.4074	.3738	.5680	.4502	.1976	.4672	.3702	739
4	.5102	.4393	.1940	.4452	.3642	.5417	.4599	.1150	.4851	.4119	.5050	.4441	.1748	.4494	.3952	.4622	.4249	.2475	.4074	.3745	.5780	.4589	.2005	.4672	.3700	739
2	.4384	.4426	.3084	.3831	.3636	.4872	.4518	.1833	.4341	.4025	.4646	.4454	.2787	.3909	.3747	.4385	.4375	.3954	.3449	.3441	.5226	.4504	.3210	.4044	.3478	184
6/12	.4349	.3418	.0454	.5291	.4157	.4718	.3719	.0271	.5419	.4271	.4309	.3501	.0406	.5245	.4261	.3824	.3231	.0571	.5014	.4227	.4964	.3878	.0460	.5454	.4041	383
10	.4352	.3514	.0867	.5101	.4118	.4700	.3797	.0400	.5283	.4268	.4311	.3594	.0601	.5068	.4225	.3851	.3346	.0848	.4787	.4159	.4959	.3757	.0686	.5274	.3996	745
8	.4165	.3418	.0926	.4895	.4017	.4489	.3674	.0557	.5147	.4214	.4138	.3493	.0840	.4885	.4123	.3722	.3288	.1186	.4552	.3997	.4734	.3630	.0964	.5075	.3892	896
6	.3388	.3331	.1304	.4561	.3909	.4157	.3529	.0782	.4909	.4168	.3866	.3389	.1182	.4582	.4016	.3523	.3216	.1673	.4188	.3823	.4400	.3490	.1360	.4757	.3773	379
4	.3586	.3190	.1659	.4238	.3790	.3779	.3332	.0992	.4664	.4112	.3550	.3232	.1503	.4285	.3901	.3282	.3109	.2129	.3852	.3649	.4017	.3299	.1730	.4441	.3646	377
2	.3332	.3164	.2117	.3868	.3673	.3490	.3243	.1263	.4365	.4056	.3323	.3189	.1917	.3942	.3783	.3129	.3124	.2718	.3488	.3482	.3735	.3221	.2209	.4076	.3514	375
5/10	.2767	.2167	.0353	.5234	.4099	.3005	.2360	.0211	.5389	.4232	.2749	.2221	.0317	.5199	.4201	.2443	.2048	.0448	.4947	.4147	.3160	.2331	.0362	.5399	.3983	888
8	.2721	.2182	.0496	.5040	.4041	.2954	.2364	.0292	.5266	.4214	.2712	.2235	.0447	.5033	.4147	.2424	.2074	.0627	.4730	.4047	.3099	.2331	.0505	.5221	.3927	748
6	.2504	.2063	.0646	.4802	.3958	.2687	.2201	.0386	.5094	.4174	.2482	.2100	.0533	.4805	.4066	.2241	.1976	.0825	.4444	.3919	.2849	.2186	.0689	.4995	.3832	741
4	.2298	.1966	.0854	.4490	.3842	.2445	.2071	.0510	.4885	.4120	.2279	.1995	.0772	.4516	.3963	.2084	.1902	.1094	.4103	.3744	.2605	.2060	.0888	.4691	.3709	144
2	.2105	.1957	.1265	.3951	.3674	.2221	.2014	.0758	.4437	.4042	.2099	.1975	.1149	.4019	.3781	.1969	.1927	.1628	.3584	.3489	.2370	.2004	.1325	.4159	.3517	142
4/8	.1747	.1418	.0344	.4979	.4041	.1904	.1544	.0264	.5214	.4227	.1752	.1458	.0309	.4978	.4144	.1568	.1351	.0438	.4671	.4026	.1987	.1512	.0354	.5156	.3924	902
6	.1861	.1508	.0444	.4881	.3955	.1995	.1608	.0263	.5163	.4157	.1839	.1531	.0398	.4879	.4063	.1656	.1440	.0564	.4524	.3934	.2125	.1604	.0456	.5077	.3833	875
4	.1756	.1469	.0539	.4665	.3902	.1868	.1545	.0320	.5003	.4139	.1732	.1486	.0486	.4677	.4012	.1573	.1413	.0688	.4282	.3846	.2000	.1549	.0557	.4872	.3772	987
2	.1433	.1295	.0753	.4117	.3720	.1512	.1345	.0450	.4572	.4068	.1427	.1310	.0682	.4173	.3832	.1327	.1267	.0967	.3737	.3558	.1614	.1335	.0786	.4321	.3575	584
3/4	.0987	.0814	.0299	.4700	.3877	.1058	.0886	.0176	.5037	.4123	.0980	.0828	.0268	.4722	.3988	.0888	.0781	.0380	.4334	.3812	.1134	.0862	.030e	.4902	.3757	988
2	.0804	.0715	.0395	.4201	.3735	.0851	.0742	.0239	.4644	.4050	.0800	.0722	.0361	.4249	.3833	.0741	.0697	.0511	.3802	.3578	.0911	.0740	.0417	.4408	.3579	989
2	.0800	.0717	.0401	.4171	.3736	.0844	.0742	.0238	.4627	.4068	.0795	.0723	.0362	.4228	.3847	.0737	.0709	.0513	.3779	.3586	.0904	.0740	.0416	.4386	.3594	1301
2/2	.0501	.0448	.0268	.4111	.3683	.0528	.0462	.0158	.4598	.4023	.0496	.0451	.0241	.4182	.3792	.0462	.0438	.0343	.3720	.3534	.0568	.0463	.0277	.4339	.3540	887
10 YR. 8/6	.6637	.6251	.3640	.4274	.4026	.7067	.6539	.1580	.4654	.4306	.6622	.6358	.2390	.4308	.4137	.6099	.6138	.3380	.3906	.3930	.7451	.6438	.2744	.4480	.3870	593
4	.6301	.6081	.3419	.3993	.3841	.6640	.6244	.2040	.4449	.4184	.6285	.6128	.3093	.4053	.3952	.5872	.5987	.4381	.3616	.3686	.7064	.6183	.3557	.4304	.3679	589
7/10	.4853	.4343	.0584	.4962	.4440	.5290	.4705	.0353	.5112	.4546	.4860	.4481	.0525	.4926	.4542	.4348	.4207	.0735	.4680	.4529	.5470	.4571	.0594	.5144	.4248	603
8	.4977	.4542	.1031	.4718	.4305	.5380	.4851	.0618	.4959	.4471	.4973	.4658	.0929	.4709	.4411	.4491	.4423	.1308	.4393	.4327	.5611	.4745	.1058	.4916	.4157	744
6	.4832	.4463	.1471	.4486	.4148	.5192	.4729	.0896	.4804	.4375	.4833	.4546	.1335	.4502	.4254	.4406	.4367	.1884	.4135	.4098	.5436	.4635	.1530	.4686	.3995	601
4	.4945	.4688	.2362	.4122	.3909	.5241	.4866	.1414	.4549	.4234	.4937	.4754	.2140	.4173	.4018	.4531	.4616	.3028	.3747	.3776	.5554	.4808	.2460	.4332	.3750	600
6/10	.4211	.3736	.0530	.4967	.4408	.4591	.4028	.0307	.5145	.4511	.4214	.3839	.0462	.4949	.4508	.3764	.3808	.0863	.4690	.4496	.4753	.3928	.0520	.5166	.4289	1422
8	.4007	.3581	.0776	.4791	.4281	.4350	.3841	.0461	.5028	.4439	.4013	.3675	.0695	.4787	.4384	.3610	.3470	.0980	.4479	.4305	.4521	.3753	.0791	.4988	.4140	749
6	.3876	.3501	.0985	.4636	.4187	.4176	.3720	.0589	.4921	.4384	.3869	.3578	.0888	.4642	.4293	.3506	.3404	.1253	.4295	.4170	.4372	.3652	.1015	.4837	.4040	750
4	.3391	.3216	.1411	.4229	.4011	.3616	.3363	.0848	.4620	.4297	.3393	.3273	.1281	.4289	.4118	.3130	.3163	.1811	.3983	.3903	.3808	.3308	.1472	.4434	.3852	605
5/8	.2449	.2180	.0373	.4896	.4358	.2681	.2366	.0220	.5090	.4492	.2467	.2251	.0332	.4886	.4457	.2205	.2106	.0488	.4617	.4403	.2754	.2288	.0377	.5082	.4222	612
6	.2434	.2189	.0622	.4640	.4174	.2624	.2326	.0371	.3932	.4371	.2431	.2237	.0559	.4650	.4279	.2202	.2128	.0790	.4301	.4156	.2749	.2216	.0639	.4845	.4029	743
4	.2278	.2103	.0780	.4412	.4075	.2449	.2226	.0468	.4762	.4327	.2285	.2150	.0707	.4444	.4181	.2089	.2055	.1000	.4061	.3995	.2559	.2178	.0812	.4612	.3925	610
4/4	.1510	.1361	.0399	.4618	.4162	.1641	.1461	.0237	.4915	.4376	.1522	.1398	.0358	.4641	.4286	.1377	.1320	.0507	.4297	.4120	.1696	.1418	.0410	.4812	.4024	613
3/2	.0772	.0713	.0306	.4310	.3984	.0828	.0751	.0179	.4711	.4289	.0775	.0727	.0273	.4367	.4096	.0711	.0697	.0387	.3980	.3883	.0868	.0737	.0313	.4527	.3942	933
2/2	.0553	.0514	.0296	.4058	.3770	.0591	.0529	.0176	.4516	.4113	.0549	.0518	.0268	.4113	.3982	.0512	.0505	.0379	.3868	.3615	.0622	.0527	.0308	.4369	.3617	934
2½Y 9/4	.8337	.8293	.5138	.3830	.3810	.8750	.8479	.3018	.4321	.4188	.8338	.8373	.4601	.3910	.3930	.7841	.8247	.6538	.3465	.3645	.9315	.8404	.5284	.4049	.3684	1752*
2	.8199	.8201	.5723	.3706	.3707	.8549	.8318	.3353	.4228	.4114	.8183	.8249	.5118	.3797	.3828	.7762	.8167	.7280	.3344	.3519	.9148	.8268	.5981	.3927	.3549	1751*
9/8	.7767	.7553	.3869	.4318	.4199	.8323	.7871	.1560	.4688	.4433	.7767	.7677	.2369	.4380	.4310	.7116	.7442	.3360	.3971	.4184	.8718	.7754	.2700	.4547	.4044	1730*
6	.7402	.7284	.3481	.4074	.4009	.7852	.7500	.2024	.4519	.4316	.7391	.7285	.3088	.4142	.4127	.6856	.7205	.4391	.3715	.3966	.8390	.7423	.3521	.4308	.3857	1729*
4	.7401	.7371	.4198	.3901	.3826	.7786	.7540	.2443	.4382	.4243	.7379	.7442	.3732	.3977	.4011	.6917	.7325	.5210	.3536	.3749	.8269	.7488	.4275	.4128	.3736	1728*
2	.7229	.7252	.5153	.3682	.3694	.7534	.7323	.3003	.4215	.4102	.7206	.7278	.4593	.3777	.3815	.6944	.7238	.6319	.3321	.3807	.8068	.7302	.5273	.3909	.3637	1727*
5Y 9/6	.7896	.8052	.3758	.4007	.4086	.8372	.8249	.2193	.4450	.4384	.7894	.8135	.3339	.4076	.4200	.7335	.7907	.4742	.3654	.3984	.8818	.8154	.3815	.4242	.3923	1713*
4	.7794	.7916	.4684	.3822	.3862	.8184	.8043	.2727	.4315	.4241	.7782	.7968	.4176	.3936	.3999	.7316	.7678	.5827	.3482	.3728	.8698	.7904	.4786	.4052	.3719	1712*
2	.7903	.7976	.5488	.3699	.3733	.8239	.8059	.3196	.4227	.4134	.7863	.8008	.4987	.3794	.3854	.7473	.7945	.6958	.3340	.3561	.8814	.8024	.5908	.3927	.3575	1711*
9/14	.6889	.6812	.0633	.4732	.4830	.7287	.7222	.0367	.4899	.4856	.6706	.6997	.0540	.4796	.4913	.6021	.6728	.0751	.4460	.4984	.7478	.7021	.0884	.4958	.4886	1705*

* Spectrophotometric measurements on starred painting numbers were made by W. C. Granville (‡); all others were made at the National Bureau of Standards.

TABLE II.—Tristimulus values and chromaticity coordinates of selected Munsell standards for five illuminants, in addition to four published J.O.S.A. July 1943, based on spectrophotometric data.—(continued).

Munsell notation	ICI B Illuminant					Fluorescent 3500K					Fluorescent 4500K					Fluorescent 6500K					Fluorescent Soft White					Munsell painting number
	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	
12	.6769	.6873	.1352	.4515	.4584	.7320	.7202	.0787	.4781	.4705	.6778	.7016	.1184	.4525	.4684	.6140	.6790	.1669	.4205	.4651	.7570	.7046	.1338	.4748	.4419	1704*
10	.6756	.6854	.1766	.4396	.4460	.7271	.7130	.1018	.4716	.4624	.6756	.6958	.1541	.4428	.4565	.6150	.6772	.2182	.4072	.4484	.7553	.7001	.1738	.4638	.4297	1703*
8	.6789	.6873	.2300	.4253	.4306	.7263	.7105	.1330	.4627	.4526	.6782	.6966	.2024	.4300	.4417	.6218	.6798	.2872	.3914	.4279	.7587	.7000	.2297	.4493	.4146	1702*
6	.6774	.6915	.2966	.4067	.4152	.7196	.7087	.1716	.4498	.4429	.6765	.6984	.2618	.4134	.4267	.6262	.6860	.3722	.3718	.4073	.7563	.7007	.2983	.4309	.3992	1701*
4	.6828	.6947	.3595	.3930	.4000	.7198	.7075	.2086	.4400	.4325	.6807	.6995	.3185	.4007	.4118	.6353	.6898	.4531	.3573	.3879	.7612	.7014	.3640	.4167	.3840	1700*
2	.6911	.6948	.4828	.3699	.3718	.7187	.7006	.2810	.4227	.4121	.6877	.6965	.4296	.3791	.3840	.6523	.6916	.6117	.3335	.3537	.7702	.6986	.4930	.3926	.3561	1699*
8/12	.5905	.5865	.0526	.4759	.4809	.6351	.6331	.0324	.4883	.4868	.5852	.6090	.0471	.4715	.4906	.5262	.5806	.0650	.4491	.4955	.6478	.6080	.0521	.4949	.4853	62
10	.5910	.5938	.0720	.4702	.4725	.6439	.6352	.0431	.4870	.4804	.5940	.6131	.0637	.4674	.4825	.5350	.5888	.0888	.4419	.4848	.6607	.6147	.0709	.4908	.4546	807a
8	.5900	.5850	.1348	.4462	.4561	.6286	.6096	.0770	.4771	.4643	.5807	.5948	.1168	.4483	.4602	.5265	.5766	.1656	.4150	.4545	.6488	.5982	.1312	.4707	.4341	852
8	.5859	.5913	.1324	.4474	.4515	.6331	.6163	.0755	.4778	.4651	.5886	.6013	.1147	.4503	.4616	.5315	.5828	.1626	.4163	.4564	.6554	.6047	.1287	.4719	.4354	852
6	.5857	.5887	.2093	.4233	.4255	.6263	.6142	.1244	.4589	.4500	.5864	.6002	.1879	.4266	.4367	.5397	.5834	.2656	.3826	.4201	.6546	.6019	.2147	.4449	.4093	1221
4	.5693	.5720	.2966	.3975	.3994	.6012	.5876	.1715	.4420	.4319	.5684	.5786	.2607	.4038	.4110	.5304	.5679	.3696	.3612	.3958	.6357	.5804	.2988	.4196	.3831	56
2	.5580	.5603	.3815	.3720	.3736	.5814	.5668	.2255	.4239	.4132	.5559	.5427	.3411	.3899	.3855	.5267	.5578	.4850	.3356	.3554	.6224	.5643	.3917	.3943	.3575	54
7/10	.4330	.4306	.0550	.4714	.4687	.4735	.4624	.0331	.4886	.4772	.4389	.4451	.0490	.4692	.4781	.3931	.4242	.0684	.4438	.4790	.4837	.4457	.0548	.4914	.4528	904
8	.4275	.4329	.0585	.4653	.4711	.4667	.4647	.0350	.4829	.4808	.4312	.4481	.0520	.4630	.4811	.3891	.4284	.0726	.4371	.4813	.4765	.4477	.0582	.4851	.4557	70
6	.4280	.4251	.1135	.4428	.4398	.4623	.4484	.0672	.4727	.4585	.4300	.4354	.1014	.4448	.4503	.3916	.4195	.1432	.4104	.4396	.4785	.4389	.1153	.4642	.4239	390
4	.4342	.4344	.2003	.4062	.4064	.4616	.4488	.1182	.4488	.4363	.4348	.4405	.1794	.4122	.4176	.4034	.4305	.2544	.3707	.3956	.4854	.4419	.2055	.4285	.3901	388
2	.4446	.4483	.2974	.3735	.3766	.4654	.4554	.1762	.4242	.4151	.4448	.4514	.2678	.3821	.3878	.4208	.4465	.3800	.3374	.3579	.4963	.4518	.3090	.3952	.3597	387
6/8	.3229	.3230	.0481	.4654	.4654	.3547	.3475	.0288	.4852	.4753	.3278	.3344	.0429	.4648	.4743	.2952	.3183	.0801	.4383	.4725	.3605	.3336	.0483	.4855	.4494	903
8	.3323	.3329	.0488	.4654	.4662	.3650	.3581	.0292	.4852	.4760	.3373	.3447	.0435	.4649	.4752	.3038	.3282	.0809	.4384	.4737	.3710	.3439	.0489	.4858	.4502	903
6	.3277	.3257	.0656	.4557	.4530	.3560	.3449	.0388	.4812	.4663	.3297	.3341	.0583	.4565	.4627	.2963	.3208	.0821	.4254	.4575	.3864	.3352	.0658	.4774	.4368	1212
4	.3158	.3152	.1277	.4163	.4155	.3376	.3279	.0755	.4556	.4425	.3169	.3207	.1144	.4214	.4265	.2924	.3118	.1621	.3815	.4070	.3528	.3215	.1309	.4382	.3993	392
2	.3217	.3236	.2046	.3785	.3808	.3376	.3298	.1212	.4281	.4182	.3219	.3263	.1842	.3867	.3920	.3036	.3221	.2613	.3423	.3631	.3592	.3287	.2116	.4002	.3640	391
5/6	.2020	.2033	.0406	.4529	.4560	.2208	.2178	.0244	.4769	.4704	.2048	.2101	.0365	.4537	.4654	.1854	.2005	.0513	.4241	.4586	.2244	.2089	.0414	.4726	.4401	947
4	.2015	.2023	.0727	.4229	.4245	.2169	.2121	.0431	.4595	.4492	.2031	.2067	.0652	.4276	.4352	.1867	.2001	.0923	.3896	.4178	.2248	.2066	.0745	.4443	.4084	394
2	.2125	.2136	.1300	.3822	.3841	.2233	.2180	.0767	.4311	.4208	.2126	.2155	.1167	.3902	.3955	.2001	.2124	.1657	.3480	.3674	.2373	.2158	.1341	.4041	.3676	395
4/4	.1269	.1268	.0413	.4301	.4298	.1372	.1339	.0242	.4646	.4536	.1281	.1300	.0367	.4346	.4409	.1172	.1251	.0520	.3982	.4250	.1410	.1297	.0418	.4512	.4149	412
2	.1418	.1433	.0830	.3852	.3893	.1494	.1466	.0490	.4330	.4249	.1419	.1447	.0745	.3930	.4007	.1333	.1425	.1057	.3494	.3735	.1582	.1448	.0856	.4071	.3727	397
3/2	.0689	.0695	.0432	.3795	.3825	.0723	.0709	.0254	.4290	.4204	.0689	.0701	.0387	.3878	.3944	.0690	.0692	.0550	.3435	.3657	.0768	.0702	.0444	.4013	.3865	398
2/2	.0480	.0476	.0272	.3904	.3879	.0504	.0485	.0157	.4395	.4234	.0477	.0479	.0241	.3988	.4002	.0446	.0471	.0343	.3541	.3739	.0534	.0481	.0275	.4126	.3731	858
7½Y 9/8	.8164	.8520	.2400	.4278	.4464	.8778	.8833	.1395	.4619	.4648	.8184	.8566	.2113	.4316	.4570	.7486	.8463	.2990	.3953	.4469	.9115	.8985	.2389	.4519	.4296	1726*
6	.8152	.8460	.3432	.4067	.4221	.8584	.8692	.2003	.4481	.4485	.8162	.8567	.3046	.4128	.4332	.7553	.8416	.4321	.3722	.4148	.9097	.8568	.3471	.4304	.4054	1725*
4	.8264	.8520	.4527	.3878	.3998	.8717	.8676	.2843	.4351	.4330	.8262	.8590	.4029	.3957	.4114	.7733	.8487	.5725	.3524	.3867	.9218	.8593	.4610	.4111	.3833	1724*
2	.8040	.8202	.5611	.3679	.3753	.8388	.8282	.3296	.4203	.4150	.8030	.8237	.5014	.3773	.3871	.7618	.8184	.7131	.3322	.3569	.8964	.8241	.5756	.3904	.3589	1723*
9/10	.6522	.6923	.0945	.4532	.4811	.7085	.7201	.0520	.4785	.4863	.6538	.7049	.0786	.4549	.4904	.5894	.6865	.1109	.4250	.4950	.7278	.7050	.0854	.4794	.4644	1718*
8	.6530	.6861	.1974	.4250	.4465	.7009	.7044	.1104	.4624	.4648	.6529	.6937	.1691	.4307	.4577	.5964	.6807	.2410	.3929	.4484	.7282	.6948	.1869	.4515	.4308	1717*
6	.6520	.6761	.2858	.4040	.4189	.6925	.6889	.1627	.4485	.4461	.6507	.6810	.2493	.4116	.4307	.6020	.6714	.3554	.3898	.4122	.7269	.6826	.2832	.4294	.4033	1716*
4	.6775	.6968	.3855	.3850	.3959	.7126	.7053	.2206	.4349	.4304	.6756	.6998	.3385	.3942	.4083	.6326	.6932	.4829	.3497	.3833	.7549	.7013	.3964	.4097	.3906	1715*
2	.6881	.6998	.4854	.3686	.3740	.7144	.7042	.2823	.4200	.4140	.6841	.7014	.4318	.3764	.3880	.6493	.6979	.6148	.3309	.3557	.7645	.7021	.4953	.3897	.3879	1714*
10Y 8/8	.5644	.6128	.1192	.4354	.4727	.6142	.6400	.0689	.4642	.4837	.5704	.6271	.1037	.4384	.4819	.5183	.6114	.1461	.4063	.4792	.6289	.6327	.1158	.4599	.4554	599
6	.5659	.6060	.2203	.4065	.4353	.6067	.6251	.1286	.4460	.4595	.5698	.6161	.1952	.4126	.4461	.5262	.6051	.2766	.3737	.4298	.6298	.6123	.2220	.4302	.4182	581
4	.5746	.5942	.3120	.3854	.4053	.6090	.6190	.1838	.4314	.4385	.5778	.6122	.2794	.3932	.4166	.5412	.6039	.3963	.3511	.3918	.6397	.6090	.3200	.4078	.3882	578
7/8	.4162	.4521	.0658	.4455	.4840	.4591	.4806	.0383	.4694	.4914	.4253	.4674	.0573	.4477	.4920	.3845	.4513	.0804	.4197	.4926	.4636	.4620	.0636	.4687	.4870	862
6	.4028	.4396	.1114	.4223	.4610	.4364	.4624	.0667	.4520	.4789	.4079	.4523	.1000	.4248	.4710	.3741	.4402	.1407	.3917	.4609	.4464	.4465	.1135	.4436	.4436	604
4	.4212	.4479	.2100	.3903	.4151	.4481	.4621	.1252	.4328	.4463	.4244	.4457	.1894	.3968	.4261	.3965	.4480	.2679	.3564	.4027	.4675	.4516	.2171	.4115	.3975	606
6/6	.3099	.3335	.0622	.4392	.4727	.3409	.3531	.0358	.4671	.4838	.3165	.3438	.0541	.4430	.4813	.2868	.3322	.0763	.4125	.4777	.3449	.3400	.0605	.4627	.4561	617
4	.3152	.3328	.1345	.4028	.4253	.3366	.3433	.0792	.4434	.4523	.3169	.3382	.1200	.4089	.4363	.2938	.3319	.1700	.3692	.4171	.3507	.3364	.1370	.4256	.4082	615
5/6	.2114	.2285	.0544	.4277	.4624	.2304	.2408	.0319	.4579	.4757	.2148	.2349	.0481	.4315	.4719	.1960	.2276	.0679	.3988	.4631	.2338	.2317	.0544	.4497	.4457	921
4	.2089	.2250	.0776	.4085	.4398	.2254	.2338	.0453	.4468	.4635	.2116	.2297	.0687	.4148	.4504	.1950	.2246	.0974	.3772	.4344	.2319	.2274	.0781	.4315	.4231	619
4/4	.1304	.1402	.0490	.4082	.4386	.1407	.1464	.0292	.4448	.4630	.1322	.1435	.0440	.4135	.4488	.1220	.1398	.0622	.3766	.4315	.1443	.1416	.0503	.4292	.4212	622
3/2	.0755	.0793	.0435	.3808	.4000	.0800	.0810	.0253	.4296	.4348	.0760	.0802	.0386	.3901	.4119	.0713	.0794	.0549	.3469	.3861	.0842	.0800	.0441	.4043	.3838	935
2/2	.0468	.0487	.0278	.3795	.3952	.0492	.0496	.0161	.4283	.4314	.0468	.0491	.0246	.3883	.4074	.0440	.0486	.0351	.3448	.3803	.0519	.0489	.0282	.4022	.3791	939
8GY 9/5	.6320	.7043	.3070	.3846	.4286	.6712	.7120	.1707	.4319	.4582	.6339	.7096	.2635	.3945	.4416	.5904	.7067	.3771	.3526	.4221	.7001	.7036	.2981	.4114	.4134	1597
1	.7229	.7417	.3612	.3568	.3661	.7489	.7427	.3252	.4122	.4088	.7207	.7421	.4994	.3675	.3784	.6885	.7414	.7103	.3217	.3464	.8047	.7418	.5718	.3799	.3502	2593
8/8	.5133	.5053	.1539	.4034	.4757	.5575	.6198	.0863	.4412	.4905	.5214	.6155	.1316	.4110	.4852	.4785	.6102	.1869	.3751	.4784	.5686	.6051	.1468	.4306	.4582	432

6	.5215	.3949	.2256	.3896	.4433	.5573	.6022	.1284	.4327	.4676	.5251	.6003	.1962	.3973	.4542	.4873	.5979	.2792	.3571	.4362	.5777	.5932	.2216	.4148	.4259	433
4	.5520	.6055	.3907	.3710	.4067	.5818	.6086	.1907	.4212	.4406	.5538	.6080	.2916	.3810	.4183	.5212	.6071	.4152	.3377	.3934	.6127	.6032	.3328	.3966	.3895	434
2	.5571	.5856	.4069	.3595	.3779	.5804	.5874	.2376	.4130	.4179	.5572	.5870	.3628	.3697	.3865	.5305	.5865	.5161	.3248	.3591	.6198	.5847	.4162	.3834	.3606	435
7/10	.3542	.4294	.0729	.4135	.5014	.3892	.4476	.0422	.4428	.5092	.3630	.4418	.0631	.4182	.5090	.3316	.4348	.0886	.3878	.5086	.3910	.4310	.0698	.4384	.4833	908
8	.3800	.4535	.1162	.4001	.4775	.4113	.4662	.0664	.4358	.4939	.3856	.4626	.1006	.4064	.4875	.3552	.4583	.1425	.3715	.4794	.4191	.4531	.1128	.4255	.4800	442
6	.3896	.4528	.1523	.3917	.4552	.4185	.4618	.0871	.4326	.4774	.3938	.4594	.1327	.3995	.4659	.3648	.4563	.1885	.3613	.4520	.4307	.4518	.1498	.4172	.4577	441
4	.3959	.4379	.2213	.3752	.4151	.4191	.4425	.1279	.4236	.4472	.3981	.4413	.1952	.3847	.4266	.3735	.4399	.2777	.3423	.4031	.4393	.4370	.2228	.3997	.4377	439
2	.4034	.4265	.2882	.3608	.3815	.4212	.4284	.1687	.4136	.4307	.4040	.4280	.2573	.3709	.3929	.3842	.4274	.3658	.3263	.3630	.4487	.4259	.2951	.3836	.3841	437
6/8	.3750	.3258	.0823	.4026	.4770	.3991	.3370	.0475	.4375	.4930	.3903	.3334	.0719	.4088	.4864	.3578	.3291	.1016	.3745	.4780	.3937	.3284	.0807	.4273	.4592	715
6	.2701	.3217	.0896	.3964	.4721	.2917	.3325	.0529	.4308	.4911	.2743	.3295	.0798	.4014	.4821	.2539	.3258	.1122	.3670	.4709	.2976	.3230	.0900	.4194	.4537	446
4	.2879	.3228	.1474	.3798	.4258	.3061	.3278	.0857	.4254	.4556	.2901	.3264	.1304	.3884	.4370	.2714	.3247	.1852	.3474	.4156	.3192	.3224	.1486	.4039	.4080	445
2	.3080	.3250	.2138	.3623	.3946	.3201	.3273	.1259	.4139	.4233	.3066	.3287	.1917	.3719	.3959	.2916	.3250	.2721	.3278	.3663	.3405	.3247	.2200	.3847	.3668	444
5/8	.1701	.2110	.0454	.3988	.4948	.1848	.2202	.0271	.4277	.5096	.1736	.2176	.0405	.4022	.5041	.1603	.2146	.0567	.3714	.4972	.1857	.2109	.0455	.4201	.4770	450
6	.1741	.2074	.0672	.3880	.4623	.1874	.2137	.0397	.4251	.4848	.1769	.2121	.0598	.3941	.4726	.1645	.2102	.0845	.3582	.4578	.1917	.2071	.0679	.4107	.4438	720
4	.1823	.2078	.0873	.3818	.4352	.1946	.2128	.0516	.4240	.4636	.1844	.2113	.0781	.3892	.4460	.1724	.2096	.1105	.3501	.4255	.2016	.2077	.0891	.4045	.4168	449
2	.1955	.2101	.1308	.3644	.3917	.2051	.2122	.0772	.4147	.4291	.1962	.2117	.1174	.3738	.4029	.1862	.2110	.1665	.3304	.3742	.2173	.2099	.1346	.3868	.3736	448
4/6	.1072	.1254	.0459	.3849	.4503	.1151	.1290	.0270	.4245	.4758	.1088	.1279	.0409	.3920	.4608	.1014	.1266	.0578	.3548	.4430	.1177	.1250	.0465	.4071	.4322	907
4	.1155	.1317	.0594	.3766	.4296	.1231	.1346	.0350	.4205	.4660	.1169	.1338	.0530	.3849	.4465	.1096	.1327	.0752	.3452	.4181	.1273	.1313	.0806	.3989	.4113	460
2	.1258	.1358	.0854	.3625	.3915	.1319	.1371	.0503	.4130	.4293	.1264	.1368	.0766	.3719	.4027	.1200	.1364	.1087	.3286	.3738	.1397	.1355	.0878	.3847	.3733	459
3/4	.0658	.0740	.0365	.3730	.4198	.0699	.0756	.0212	.4192	.4534	.0665	.0751	.0324	.3823	.4316	.0625	.0745	.0460	.3415	.4070	.0724	.0738	.0370	.3954	.4027	768
2	.0691	.0750	.0439	.3676	.3990	.0728	.0761	.0258	.4168	.4356	.0695	.0758	.0392	.3769	.4106	.0653	.0754	.0557	.3341	.3830	.0767	.0750	.0449	.3900	.3814	462
2/2	.0413	.0461	.0286	.3626	.4043	.0433	.0462	.0152	.4137	.4415	.0414	.0462	.0233	.3731	.4170	.0391	.0463	.0332	.3299	.3900	.0454	.0456	.0266	.3862	.3880	889
10GY 8/6	.4794	.5755	.3182	.3491	.4191	.5090	.5757	.1812	.4021	.4548	.4878	.5798	.2782	.3624	.4308	.4625	.5846	.3989	.3203	.4048	.5293	.5672	.3166	.3746	.4014	863
4	.5292	.6144	.3837	.3465	.4023	.5570	.6141	.2206	.4002	.4413	.5358	.6181	.3381	.3591	.4143	.5108	.6227	.4819	.3162	.3855	.5850	.6089	.3861	.3707	.3846	611
7/8	.3193	.4348	.1761	.3432	.4674	.3444	.4334	.0973	.3936	.4952	.3287	.4394	.1500	.3580	.4785	.3098	.4463	.2145	.3192	.4598	.3489	.4237	.1685	.3707	.4802	635
6	.3487	.4465	.2170	.3445	.4411	.3687	.4427	.1250	.3938	.4727	.3533	.4487	.1906	.3596	.4520	.3355	.4559	.2708	.3159	.4292	.3820	.4360	.2163	.3693	.4215	616
4	.3852	.4545	.2737	.3480	.4082	.4041	.4553	.1603	.3963	.4455	.3891	.4581	.2440	.3566	.4193	.3719	.4615	.3464	.3152	.3912	.4239	.4480	.2792	.3683	.3862	614
8/10	.2101	.2995	.0968	.3464	.4940	.2278	.2981	.0535	.3932	.5145	.2166	.3029	.0821	.3600	.5035	.2031	.3084	.1170	.3232	.4907	.2289	.2909	.0914	.3745	.4759	634
8	.2342	.3189	.1197	.3482	.4740	.2523	.3176	.0648	.3975	.5004	.2401	.3220	.1004	.3624	.4860	.2255	.3271	.1440	.3238	.4695	.2557	.3109	.1123	.3767	.4579	751
6	.2357	.3134	.1375	.3432	.4585	.2504	.3107	.0796	.3912	.4853	.2397	.3154	.1204	.3549	.4670	.2272	.3211	.1709	.3159	.4464	.2575	.3052	.1342	.3685	.4396	624
4	.2497	.3074	.1781	.3397	.4181	.2622	.3055	.1036	.3906	.4551	.2526	.3090	.1578	.3512	.4294	.2417	.3131	.2243	.3102	.4019	.2739	.3069	.1802	.3629	.3988	621
5/8	.1293	.1886	.0622	.3403	.4961	.1386	.1873	.0355	.3835	.5183	.1324	.1907	.0539	.3511	.5059	.1252	.1948	.0764	.3159	.4914	.1401	.1825	.0804	.3659	.4764	881
6	.1532	.2116	.0806	.3439	.4751	.1635	.2092	.0456	.3909	.5001	.1590	.2129	.0696	.3558	.4854	.1473	.2173	.0990	.3178	.4687	.1668	.2053	.0782	.3704	.4559	628
4	.1626	.2009	.1089	.3442	.4252	.1713	.1997	.0631	.3947	.4599	.1646	.2019	.0952	.3557	.4363	.1588	.2046	.1368	.3147	.4107	.1786	.1968	.1096	.3682	.4057	636
4/6	.0976	.1336	.0596	.3355	.4594	.1034	.1311	.0337	.3857	.4887	.0992	.1338	.0516	.3484	.4703	.0942	.1371	.0735	.3091	.4499	.1064	.1293	.0582	.3620	.4400	727
4	.1031	.1321	.0735	.3339	.4279	.1082	.1301	.0423	.3857	.4635	.1043	.1323	.0646	.3463	.4393	.0999	.1356	.0919	.3056	.4132	.1128	.1285	.0735	.3584	.4082	630
3/4	.0555	.0746	.0358	.3347	.4498	.0583	.0730	.0201	.3849	.4822	.0590	.0745	.0309	.3469	.4618	.0534	.0783	.0440	.3071	.4394	.0602	.0721	.0349	.3603	.4312	633
2	.0371	.0437	.0274	.3426	.4037	.0384	.0431	.0157	.3954	.4434	.0370	.0436	.0240	.3537	.4167	.0355	.0443	.0343	.3110	.3882	.0406	.0428	.0274	.3865	.3963	937
5G 9/3	.6416	.7111	.5677	.3341	.3703	.6638	.7045	.3288	.3916	.4156	.6446	.7111	.5017	.3471	.3828	.6229	.7191	.7159	.3027	.3494	.7101	.7022	.5750	.3573	.3534	2244*
2	.6713	.7211	.5829	.3398	.3651	.6940	.7167	.3380	.3969	.4099	.6729	.7211	.5178	.3520	.3772	.6488	.7264	.7379	.3070	.3438	.7449	.7152	.5941	.3626	.3481	2243*
0.5	.6962	.7136	.5883	.3484	.3571	.7181	.7128	.3444	.4045	.4015	.6947	.7136	.5263	.3591	.3688	.6683	.7145	.7490	.3135	.3352	.7750	.7123	.6051	.3704	.3404	2241*
8/6	.4471	.5508	.4163	.3161	.3895	.4644	.5405	.2299	.3761	.4377	.4531	.5508	.3576	.3323	.4045	.4399	.5531	.5139	.2900	.3712	.4896	.5365	.4070	.3416	.3744	214
4	.5023	.5818	.4462	.3282	.3802	.5199	.5732	.2554	.3856	.4251	.5055	.5811	.3925	.3418	.3929	.4891	.5906	.5605	.2962	.3601	.5536	.5707	.4490	.3519	.3627	753
2	.5112	.5657	.4397	.3371	.3732	.5300	.5622	.2543	.3936	.4175	.5140	.5684	.3898	.3495	.3853	.4957	.5716	.5557	.3054	.3522	.5659	.5592	.4468	.3600	.3557	212
7/6	.3266	.4291	.3187	.3040	.3994	.3380	.4146	.1749	.3844	.4470	.3310	.4266	.2724	.3214	.4142	.3232	.4409	.3917	.2798	.3815	.3558	.4131	.3092	.3300	.3832	755
4	.3482	.4275	.3242	.3166	.3886	.3614	.4193	.1817	.3755	.4357	.3527	.4273	.2811	.3324	.4027	.3427	.4369	.4030	.2896	.3694	.3818	.4164	.3205	.3413	.3722	184
2	.3770	.4198	.3358	.3329	.3706	.3900	.4161	.1944	.3698	.4159	.3791	.4200	.2979	.3456	.3828	.3667	.4246	.4246	.3016	.3492	.4189	.4140	.3416	.3556	.3531	182
6/6	.2021	.2956	.2054	.2874	.4205	.2087	.2811	.1088	.3487	.4696	.2054	.2926	.1711	.3069	.4374	.2016	.3063	.2475	.2668	.4055	.2175	.2806	.1928	.3147	.4062	206
4	.2444	.3097	.2293	.3120	.3953	.2535	.3022*	.1284	.3706	.4417	.2478	.3091	.1986	.3280	.4091	.2411	.3173	.2846	.2860	.3764	.2872	.3002	.2282	.3367	.3782	204
2	.2620	.3002	.2352	.3286	.3765	.2710	.2963	.1363	.3850	.4211	.2637	.3001	.2038	.3414	.3934	.2555	.3045	.2974	.2940	.3551	.2890	.2948	.2394	.3511	.3581	202
5/8	.1124	.1814	.1141	.2755	.4447	.1157	.1682	.0598	.3367	.4895	.1139	.1776	.0941	.2965	.4606	.1129	.1888	.1361	.2564	.4320	.1202	.1696	.1053	.3043	.4292	1260
6	.1237	.1818	.1204	.2904	.4258	.1273	.1708	.0669	.3488	.4679	.1250	.1787	.1033	.3071	.4390	.1225	.1880	.1480	.2672	.4100	.1339	.1718	.1169	.3189	.4065	756
4	.1371	.1820	.1280	.3081	.4089	.1421	.1762	.0713	.3648	.4523	.1385	.1812	.1097	.3233	.4215	.1354	.1871	.1567	.2825	.3905	.1495	.1752	.1248	.3325	.3898	174
2	.1520	.1868	.1465	.3270	.3772	.1673	.1841	.0850	.3833	.4218	.1630	.1866	.1301	.3398	.3891	.1581	.1896	.1853	.2946	.3558	.1784	.1832	.1491	.3494	.3587	172
4/6	.0909	.1261	.0869	.2991	.4149	.0935	.1201	.0494	.3555	.4565	.0917	.1246	.0758	.3140	.4285	.0898	.1306	.1081	.2738	.3964	.0987	.1202	.0762	.3236	.3940	194
2	.1073	.1267	.0977	.3236	.3819	.1108	.1244	.0565	.3798	.4267	.1080	.1264	.0864	.3366	.3941	.1049	.1288	.1231	.2939	.3611	.1179	.1234	.0989	.3462	.3633	192
3/4	.0545	.0783	.0504	.2974	.4273	.0559	.0735	.0283	.3544	.4661	.0547	.0768	.0436	.3124	.4388	.0534	.0807	.0623	.2730	.4109	.0591	.0741	.0403	.3238	.4080	1264
2	.0565	.0693	.0515	.3186	.3909	.0580	.0672	.0298	.3743	.4334	.0566	.0688	.0456	.3312	.4023	.0551	.0707	.0849	.2890	.3707	.0619	.0672	.0521	.3416	.3708	188
2/2	.0301	.0366	.0290	.3144	.3824	.0303	.0346	.0164	.3725	.4257	.0296	.0358	.0253	.3365	.3945	.0290	.0372	.0362	.2829	.3634	.0339	.0352	.0288	.3393	.3630	752
10G 8/2	.5379	.5924	.4686	.3364	.3705	.5565	.5871	.2703	.3936	.4152	.5400	.5922	.4148	.3491	.3828	.5210	.5982	.5916	.3045	.3497	.5987	.5854	.4753	.3596	.3534	938
7/4	.3844	.4800	.3792	.3141	.3760	.3955	.4485	.2149	.3735	.4236	.3874	.4580	.3316	.3292	.3891	.3782	.4692	.4744	.2861	.3550	.4236	.4479	.3789	.3382	.3585	627
6/6	.2581	.3449	.2370	.2900	.3875	.2635	.3280	.1570	.3519	.4383	.2804	.3404	.2448	.3079	.4026	.2572	.3552	.3525	.2666	.3681	.2804	.3294	.2780	.3158	.3710	757
4	.2676	.3360	.2872	.3004	.3772	.2732	.3224	.1638	.3598	.4345	.2695	.3334	.2519	.3156	.3893	.2656	.3444	.3599	.2738	.3551	.2932	.3236	.2879	.3241	.3577	625
5/6	.1280	.1940	.1645	.2830	.3988	.1286	.1782	.0950	.3232	.4548	.1296	.1839	.1350	.2842	.4175	.1288	.2016	.1964	.2446	.3827	.1348	.1812	.1519	.2912	.3856	644

* Spectrophotometric measurements on starred painting numbers were made by W. C. Granville (3); all others were made at the National Bureau of Standards.

TABLE II.—Tristimulus values and chromaticity coordinates of selected Munsell standards for five illuminants, in addition to four published J.O.S.A. July 1943, based on spectrophotometric data.—(continued).

Munsell notation	ICI B Illuminant					Fluorescent 3500K					Fluorescent 4500K					Fluorescent 6500K					Fluorescent Soft White					Munsell painting number
	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	
4	1538	2000	1682	2946	3332	1571	1909	0958	3540	4302	1552	1976	1473	3104	3951	1534	2056	2105	3093	3611	1881	1917	1682	3184	3630	643
4/4	0915	1248	1048	2849	3388	0930	1174	0591	3450	4353	0922	1226	0911	3015	4007	0916	1287	1303	3012	3971	0896	1184	1037	3095	3680	646
3/4	0505	0729	0619	2726	3934	0507	0665	0342	3349	4395	0505	0706	0530	2900	4054	0504	0753	0761	2497	3732	0548	0682	0601	2992	3729	649
2/2	0303	0397	0340	2947	3799	0310	0372	0191	3551	4261	0306	0388	0295	3094	3923	0302	0407	0422	2872	3597	0336	0379	0336	3199	3806	939
5BG 9/1	7108	7398	6070	3455	3595	7327	7366	3530	4020	4042	7093	7391	5406	3566	3716	6829	7422	7701	3111	3381	7901	7367	6306	3679	3430	2991
8/2	5486	6032	5067	3308	3637	5656	5960	2922	3888	4101	5503	6022	4486	3437	3761	5336	6096	6400	2992	3419	6072	5951	5144	3537	3486	1107
7/4	3928	4564	4081	3124	3630	4014	4439	2344	3718	4111	3945	4532	3602	3366	3752	3869	4644	5143	2833	3401	4328	4447	4128	3353	3447	454
2	4222	4682	4048	3260	3615	4337	4604	2333	3847	4084	4234	4665	3542	3392	3738	4119	4738	5112	2949	3392	4671	4605	4103	3490	3441	708
6/6	2956	3334	3259	2863	3536	2684	3203	1821	3483	4155	2673	3328	2823	3030	3771	2686	3477	4051	2615	3410	2907	3236	3222	3104	3456	910
4	2752	3354	3138	2977	3628	2790	3213	1780	3584	4129	2762	3313	2746	3131	3756	2735	3431	3929	2709	3399	3016	3234	3140	3211	3444	457
2	3002	3385	3015	3193	3601	3067	3301	1739	3783	4072	3005	3361	2689	3326	3720	2937	3432	3808	2886	3373	3314	3313	3080	3421	3420	709
5/6	1411	2016	2086	2560	3657	1389	1821	1145	3189	4181	1407	1943	1783	2742	3786	1434	2088	2565	2356	3436	1523	1875	2026	2806	3457	1115
4	1635	2057	2027	2347	3603	1633	1940	1135	3468	4120	1628	2018	1759	3013	3734	1627	2112	2522	2598	3373	1773	1964	2008	3086	3419	476
2	1765	2045	1842	3123	3519	1798	1984	1068	3707	4090	1768	2028	1636	3255	3733	1737	2080	2331	2825	3383	1943	1990	1876	3345	3428	767
4/6	0990	1297	1432	2460	3582	0883	1175	0754	3140	4179	0898	1259	1192	2682	3759	0926	1365	1730	2303	3394	0971	1217	1349	2746	3441	478
4	1053	1373	1372	2802	3602	1070	1291	0766	3421	4130	1070	1347	1187	2969	3737	1073	1413	1704	2561	3372	1163	1308	1355	3040	3419	480
2	1157	1357	1287	3059	3590	1173	1306	0723	3657	4074	1157	1341	1118	3200	3708	1141	1382	1598	2770	3355	1271	1315	1281	3287	3401	770
3/6	0497	0732	0650	2378	3503	0474	0534	0461	3020	4041	0488	0691	0724	2563	3632	0506	0753	1046	2191	3280	0532	0668	0820	2632	3305	773
4	0510	0690	0733	2638	3570	0502	0524	0401	3287	4087	0506	0664	0628	2819	3698	0513	0712	0901	2413	3347	0554	0646	0712	2897	3379	486
2	0579	0710	0695	2918	3580	0531	0572	0396	3525	4074	0578	0697	0810	3046	3698	0575	0727	0872	2647	3343	0634	0681	0698	3150	3383	771
2/4	0286	0390	0406	2665	3548	0278	0337	0220	3337	4033	0280	0361	0344	2841	3668	0282	0390	0496	2417	3338	0310	0354	0390	2945	3358	488
2	0304	0370	0380	2941	3580	0302	0344	0203	3561	4049	0300	0359	0313	3083	3693	0298	0377	0448	2651	3355	0332	0352	0358	3187	3381	772
10BG 8/2	5694	6205	5423	3289	3581	5950	6121	3131	3874	4053	5708	6187	4807	3417	3704	5547	6287	6858	2971	3356	6308	6121	5516	3515	3411	940
7/4	3879	4474	4481	3022	3486	3918	4321	2587	3619	3991	3884	4429	3971	3162	3806	3851	4559	5687	2736	3239	4265	4344	4558	3239	3399	645
6/6	2540	3267	3704	2671	3435	2504	3038	2082	3293	3995	2536	3189	3204	2840	3571	2532	3370	4803	2447	3192	2755	3093	3659	2998	3283	648
4	2718	3242	3377	2911	3472	2729	3095	1937	3517	3938	2722	3196	2979	3080	3592	2721	3317	4256	2643	3232	2981	3124	3416	3131	3281	631
5/6	1526	2087	2712	2421	3278	1453	1844	1469	3056	3865	1508	1980	2303	2804	3419	1574	2141	3238	2235	3041	1640	1916	2623	2654	3101	634
4	1630	2004	2251	2769	3465	1615	1875	1286	3382	3925	1627	1958	1980	2924	3518	1645	2056	2830	2519	3148	1781	1909	2289	2989	3303	651
4/6	0932	1233	1674	2395	3307	0888	1135	0895	3042	3891	0918	1226	1409	2584	3451	0958	1334	2039	2211	3080	0999	1187	1600	2639	3135	652
4	0987	1250	1408	2707	3429	0974	1156	0793	3327	3947	0934	1215	1231	2858	3542	0998	1285	1763	2467	3176	1076	1182	1409	2934	3234	680
3/6	0464	0585	1009	2149	3175	0422	0570	0522	2783	3784	0448	0635	0831	2339	3319	0480	0712	1211	1999	2962	0490	0615	0941	2394	3006	668
4	0554	0747	0935	2513	3325	0543	0667	0511	3155	3877	0556	0714	0798	2690	3454	0574	0770	1150	2303	3037	0609	0694	0909	2753	3139	663
2/2	0346	0441	0486	2722	3461	0340	0399	0271	3368	3951	0342	0423	0420	2886	3569	0345	0451	0603	2469	3223	0378	0414	0479	2974	3257	941
5B 9/3	6741	7272	6970	3213	3466	6861	7149	4083	3792	3951	6737	7241	6242	3332	3581	6606	7354	8884	2892	3219	7454	7162	7180	3420	3286	2248*
2	6995	7386	6719	3315	3500	7149	7290	3932	3891	3968	6978	7356	6011	3430	3616	6791	7437	8555	2980	3264	7757	7368	6913	3529	3325	2247*
0.5	7118	7388	6405	3404	3533	7311	7349	3761	3969	3990	7104	7380	5743	3512	3648	6873	7417	8189	3060	3302	7906	7346	6607	3617	3361	2245*
8/4	5422	5950	5848	3148	3455	5498	5803	3398	3740	3948	5415	5904	5207	3277	3573	5330	6026	7422	2838	3209	5990	5830	5963	3384	3275	464
2	5710	6123	5779	3242	3477	5818	6013	3374	3826	3954	5701	6088	5163	3363	3591	5575	6178	7352	2918	3234	6324	6032	5936	3457	3298	797
7/6	3759	4338	4908	2891	3335	3745	4133	2821	3501	3863	3751	4268	4339	3036	3453	3769	4429	6199	2618	3077	4128	4185	4982	3105	3143	911
4	3990	4494	4784	3007	3337	4008	4331	2761	3611	3902	3983	4440	4240	3145	3506	3963	4571	6053	2717	3134	4393	4368	4871	3233	3304	467
2	4330	4671	4438	3222	3476	4407	4577	2589	3808	3955	4323	4640	3982	3345	3590	4232	4717	5643	2900	3232	4793	4595	4555	3438	3296	775
6/6	2447	3017	4089	2567	3165	2361	2768	2279	3187	3736	2426	2924	3535	2731	3290	2513	3110	5077	2348	2906	2655	2846	4048	2781	2980	469
4	2763	3174	3747	2853	3278	2740	3012	2157	3464	3809	2754	3117	3316	2998	3393	2778	3242	4737	2583	3014	3033	3058	3809	3064	3083	470
2	2932	3189	3347	3095	3368	2956	3095	1963	3689	3862	2925	3156	3000	3231	3475	2895	3230	4270	2785	3107	3242	3119	3453	3303	3179	798
5/6	1434	1850	2833	2345	3025	1343	1635	1548	2987	3613	1410	1764	2421	2520	3152	1495	1916	3494	2165	2775	1542	1712	2766	2562	2844	1276
4	1574	1895	2507	2633	3172	1528	1758	1422	3245	3734	1583	1845	2198	2788	3291	1611	1950	3149	2401	2906	1713	1798	2521	2840	2981	114
2	1713	1886	2048	3034	3340	1716	1820	1190	3631	3851	1705	1863	1824	3162	3454	1697	1914	2801	2732	3081	1886	1837	2096	3240	3156	112
4/8	0856	1105	2011	2154	2783	0768	0935	1072	2767	3389	0827	1032	1692	2329	2905	0902	1146	2454	2003	2546	0910	1004	1929	2368	2613	1273
6	0955	1222	2049	2280	2802	0877	1062	1109	2877	3486	0931	1156	1740	2434	3019	1001	1267	2517	2092	2647	1022	1123	1987	3473	2718	776
4	1174	1398	1903	2624	3124	1132	1270	1090	3242	3636	1158	1344	1678	2771	3214	1194	1432	2399	2377	2850	1283	1318	1926	2834	2912	914
2	1202	1348	1488	2976	3339	1200	1288	0868	3576	3837	1196	1325	1329	3107	3442	1194	1370	1893	2680	3073	1324	1305	1538	3184	3140	777
3/6	0558	0755	1346	2128	2828	0507	0629	0700	2762	3426	0545	0699	1114	2312	2904	0594	0783	1623	1980	2809	0601	0682	1265	2358	2676	494
4	0536	0671	0994	2435	3048	0507	0597	0548	3070	3613	0527	0640	0854	2607	3167	0553	0692	1230	2234	2794	0580	0624	0976	2859	2963	495
2	0614	0699	0824	2873	3270	0611	0664	0481	3479	3783	0613	0698	0736	3012	3373	0618	0714	1048	2596	2999	0677	0675	0846	3079	3070	496
2/2	0322	0374	0424	2877	3340	0318	0348	0243	3497	3831	0318	0363	0373	3015	3442	0319	0381	0534	2586	3085	0354	0398	0428	3104	3139	779

10B	8/2	.6157	.6453	.6576	.3209	.3363	.6232	.6312	.3856	.3800	.3849	.6129	.6398	.5894	.3327	.3473	.6022	.6501	.8389	.2879	.3109	.6839	.6359	.6786	.3419	.3184	942
	7/6	.3995	.4469	.5613	.2838	.3175	.3933	.4230	.3243	.3448	.3709	.3967	.4377	.4983	.2976	.3284	.4020	.4554	.7115	.2562	.2903	.4386	.4305	.5730	.3041	.2985	673
	4	.4095	.4451	.5003	.3022	.3295	.4092	.4282	.2913	.3625	.3794	.4071	.4386	.4464	.3151	.3395	.4058	.4511	.6362	.2718	.3021	.4517	.4333	.5135	.3229	.3099	780
	6/8	.2826	.3226	.4353	.2716	.3100	.2752	.3014	.2498	.3330	.3647	.2803	.3144	.3846	.2862	.3210	.2873	.3300	.5499	.2462	.2827	.3094	.3084	.4420	.2920	.2910	675
	4	.3041	.3345	.4066	.2910	.3200	.3010	.3183	.2364	.3518	.3720	.3020	.3281	.3624	.3042	.3306	.3041	.3399	.5169	.2620	.2928	.3348	.3236	.4170	.3113	.3009	781
	5/6	.1784	.2057	.3144	.2555	.2944	.1726	.1944	.1796	.3158	.3556	.1784	.2042	.2770	.2705	.3096	.1868	.2182	.3965	.2331	.2722	.1982	.2038	.3184	.2752	.2829	670
	4	.1881	.2084	.2719	.2814	.3118	.1849	.1972	.1586	.3418	.3648	.1870	.2041	.2429	.2949	.3220	.1962	.2125	.3462	.2540	.2837	.1970	.2008	.2797	.3010	.2921	640
	4/8	.1019	.1223	.2381	.2204	.2646	.0916	.1053	.1248	.2804	.3223	.0987	.1150	.2034	.2367	.2756	.1078	.1266	.2940	.2041	.2396	.1091	.1133	.2327	.2402	.2472	669
	6	.1100	.1261	.2208	.2407	.2760	.1024	.1127	.1254	.3007	.3310	.1079	.1204	.1939	.2553	.2852	.1150	.1297	.2779	.2300	.2482	.1196	.1180	.2228	.2597	.2563	782
	4	.1143	.1265	.1720	.2768	.3065	.1116	.1190	.1002	.3374	.3598	.1134	.1236	.1536	.2904	.3165	.1160	.1291	.2189	.2499	.2783	.1237	.1216	.1768	.2983	.2868	682
	3/8	.0610	.0756	.1746	.1962	.2429	.0514	.0611	.0903	.2537	.3012	.0576	.0691	.1441	.2128	.2550	.0654	.0786	.2104	.1845	.2217	.0638	.0675	.1640	.2160	.2285	661
	6	.0609	.0724	.1406	.2224	.2644	.0548	.0621	.0759	.2841	.3220	.0588	.0679	.1194	.2390	.2758	.0640	.0748	.1728	.2054	.2491	.0652	.0665	.1364	.2432	.2480	650
	4	.0601	.0683	.1072	.2551	.2897	.0570	.0620	.0606	.3173	.3451	.0590	.0656	.0938	.2702	.3004	.0617	.0699	.1346	.2318	.2628	.0686	.0645	.1077	.2758	.2713	657
	2/2	.0331	.0376	.0561	.2808	.2967	.0316	.0340	.0317	.3246	.3493	.0324	.0360	.0491	.2760	.3064	.0336	.0384	.0704	.2360	.2698	.0362	.0355	.0563	.2826	.2775	943a
5PB	9/1	.7097	.7221	.6234	.3453	.3513	.7284	.7183	.3652	.4020	.3954	.7062	.7202	.5582	.3559	.3439	.6814	.7225	.7943	.3100	.3287	.7886	.7199	.6420	.3671	.3346	2592
	8/2	.6180	.6332	.6515	.3248	.3328	.6242	.6203	.3850	.3831	.3807	.6132	.6273	.5871	.3355	.3432	.6019	.6359	.8346	.2905	.3068	.6858	.6254	.6767	.3450	.3146	808
	7/6	.4367	.4481	.5621	.2989	.3116	.4259	.4292	.3317	.3588	.3617	.4262	.4386	.5065	.3105	.3205	.4280	.4526	.7204	.2674	.2827	.4761	.4368	.5841	.3180	.2918	506
	4	.4532	.4684	.5380	.3105	.3209	.4524	.4535	.3179	.3697	.3705	.4489	.4618	.4850	.3216	.3309	.4461	.4720	.6895	.2775	.2936	.5018	.4540	.5592	.3300	.3022	786
	2	.4719	.4866	.5040	.3227	.3327	.4771	.4765	.2971	.3814	.3810	.4691	.4823	.4534	.3339	.3433	.4609	.4894	.6448	.2880	.3068	.5239	.4804	.5224	.3432	.3147	807
	6/8	.3070	.3232	.4654	.2802	.2950	.2978	.3035	.2736	.3403	.3469	.3027	.3146	.4184	.2923	.3037	.3098	.3278	.5957	.2512	.2658	.3381	.3113	.4826	.2986	.2751	1307
	6	.3232	.3336	.4654	.2880	.2973	.3158	.3165	.2762	.3476	.3483	.3194	.3280	.4212	.2994	.3057	.3247	.3375	.5985	.2576	.2677	.3572	.3236	.4863	.3061	.2773	512
	4	.3437	.3539	.4300	.3048	.3138	.3409	.3410	.2522	.3650	.3650	.3398	.3481	.3855	.3165	.3243	.3396	.3568	.5489	.2737	.2895	.3799	.3403	.4444	.3246	.2958	787
	2	.3346	.3403	.3697	.3203	.3258	.3373	.3328	.2188	.3794	.3744	.3325	.3370	.3335	.3315	.3360	.3276	.3421	.4740	.2865	.2901	.3731	.3363	.3846	.3404	.3077	784
	5/10	.2008	.2173	.4054	.2438	.2839	.1884	.1956	.2330	.3031	.3181	.1968	.2080	.3591	.2576	.2723	.2100	.2228	.5137	.2219	.2354	.2190	.2046	.4138	.2816	.2444	1303
	8	.2137	.2268	.3872	.2532	.2740	.2021	.2079	.2268	.3174	.3285	.2101	.2186	.3473	.2708	.2817	.2206	.2314	.4950	.2330	.2443	.2345	.2158	.4007	.2756	.2535	517
	6	.2092	.2187	.3272	.2771	.2895	.2025	.2054	.1940	.3364	.3412	.2067	.2129	.2959	.2886	.2976	.2125	.2221	.4206	.2485	.2597	.2369	.2108	.3417	.2947	.2891	516
	4	.2066	.2134	.2774	.2963	.3060	.2040	.2046	.1652	.3556	.3565	.2048	.2096	.2514	.3076	.3148	.2065	.2157	.3570	.2650	.2768	.2289	.2081	.2904	.3146	.2981	515
	2	.2016	.2064	.2357	.3132	.3207	.2022	.2009	.1404	.3720	.3697	.2004	.2041	.2136	.3242	.3302	.1938	.2079	.3032	.2800	.2929	.2240	.2032	.2466	.3324	.3016	785
	4/10	.1292	.1375	.3030	.2268	.2414	.1162	.1203	.1735	.2834	.2934	.1258	.1299	.2678	.2402	.2481	.1378	.1414	.3835	.2080	.2134	.1404	.1278	.3098	.2434	.2216	532
	8	.1266	.1332	.2588	.2441	.2569	.1173	.1201	.1509	.3021	.3092	.1242	.1275	.2315	.2570	.2639	.1329	.1364	.3303	.2216	.2275	.1386	.1237	.2872	.2808	.2365	522
	6	.1265	.1323	.2211	.2636	.2757	.1206	.1225	.1311	.3223	.3273	.1248	.1281	.2000	.2756	.2828	.1304	.1348	.2843	.2373	.2454	.1395	.1266	.2310	.2806	.2547	521
	4	.1290	.1328	.1855	.2883	.2989	.1263	.1263	.1108	.3475	.3476	.1277	.1300	.1685	.2996	.3050	.1298	.1344	.2392	.2579	.2679	.1428	.1290	.1947	.3061	.2765	520
	2	.1274	.1299	.1484	.3139	.3203	.1279	.1267	.0887	.3725	.3691	.1267	.1286	.1348	.3248	.3297	.1258	.1308	.1912	.2806	.2922	.1416	.1280	.1556	.3330	.3010	519
	3/12	.0716	.0746	.2230	.1940	.2020	.0594	.0606	.1170	.2506	.2557	.0677	.0681	.1843	.2114	.2128	.0780	.0742	.2069	.1840	.1867	.0759	.0665	.2112	.2146	.1881	537
	10	.0766	.0796	.2016	.2142	.2224	.0667	.0677	.1130	.2697	.2736	.0738	.0742	.1757	.2280	.2202	.0827	.0820	.2528	.1981	.1964	.0826	.0732	.2022	.2308	.2044	534
	8	.0703	.0731	.1662	.2271	.2361	.0631	.0639	.0952	.2838	.2877	.0683	.0690	.1469	.2404	.2427	.0750	.0751	.2104	.2081	.2083	.0765	.0681	.1693	.2437	.2166	532
	6	.0702	.0722	.1382	.2503	.2573	.0655	.0655	.0809	.3091	.3093	.0689	.0693	.1240	.2629	.2642	.0733	.0737	.1767	.2264	.2276	.0772	.0685	.1431	.2672	.2372	530
	4	.0664	.0682	.1077	.2743	.2814	.0641	.0640	.0641	.3336	.3328	.0657	.0684	.0976	.2880	.2889	.0678	.0693	.1387	.2480	.2511	.0736	.0653	.1128	.2916	.2610	526
	2	.0667	.0680	.0839	.3053	.3111	.0665	.0653	.0504	.3629	.3604	.0664	.0671	.0765	.3161	.3197	.0664	.0686	.1084	.2727	.2820	.0742	.0668	.0884	.3226	.2912	528
	2/6	.0368	.0383	.0905	.2224	.2313	.0328	.0326	.0510	.2810	.2803	.0355	.0356	.0791	.2364	.2371	.0391	.0393	.1136	.2038	.2046	.0400	.0384	.0910	.2406	.2126	804
	4	.0355	.0369	.0745	.2419	.2509	.0327	.0327	.0428	.3019	.3025	.0346	.0350	.0680	.2554	.2579	.0372	.0377	.0944	.2195	.2226	.0389	.0347	.0780	.2602	.2319	805
	2	.0337	.0345	.0498	.2880	.2931	.0329	.0327	.0293	.3468	.3446	.0334	.0337	.0447	.2983	.3017	.0340	.0350	.0636	.2563	.2637	.0274	.0336	.0516	.3048	.2737	806
10PB	8/2	.6473	.6463	.6745	.3289	.3284	.6546	.6348	.3974	.3881	.3763	.6419	.6404	.6068	.3396	.3390	.6286	.6474	.8639	.2939	.3026	.7211	.6417	.6993	.3497	.3112	945
	7/6	.4539	.4338	.5252	.3213	.3070	.4506	.4223	.3140	.3796	.3558	.4458	.4288	.4776	.3302	.3161	.4420	.4325	.6778	.2847	.2786	.5047	.4295	.5520	.3396	.2890	796
	4	.4612	.4479	.4891	.3299	.3203	.4638	.4396	.2905	.3885	.3682	.4554	.4429	.4425	.3397	.3303	.4470	.4470	.6286	.2936	.2936	.5142	.4454	.5108	.3497	.3029	790
	6/8	.3508	.3169	.4832	.3048	.2754	.3399	.3043	.2951	.3618	.3240	.3421	.3092	.4462	.3117	.2817	.3467	.3153	.6310	.2681	.2438	.3904	.3128	.5177	.3198	.2561	800
	6	.3371	.3134	.4291	.3123	.2903	.3307	.3024	.2576	.3713	.3396	.3299	.3068	.3914	.3209	.2984	.3305	.3123	.5559	.2759	.2606	.3754	.3096	.4530	.3298	.2722	797a
	4	.3564	.3376	.4098	.3229	.3058	.3547	.3290	.2443	.3820	.3544	.3505	.3323	.3723	.3322	.3150	.3489	.3365	.5285	.2863	.2776	.3976	.3353	.4304	.3418	.2882	791
	5/10	.2278	.1981	.3763	.2839	.2470	.2154	.1871	.2332	.3388	.2943	.2217	.1918	.3512	.2899	.2508	.2305	.1976	.4955	.2496	.2139	.2538	.1940	.4085	.2964	.2285	803
	8	.2363	.2097	.3642	.2916	.2588	.2257	.1991	.2236	.3481	.3071	.2302	.2035	.3376	.2984	.2639	.2368	.2091	.4771	.2565	.2385	.2632	.2099	.3922	.3056	.2390	801
	6	.2319	.2125	.3230	.3022	.2769	.2252	.2036	.1962	.3603	.3258	.2268	.2073	.2971	.3101	.2835	.2289	.2120	.4207	.2965	.2458	.2534	.2093	.3445	.3182	.2577	798a
	4	.2316	.2165	.2863	.3153	.2948	.2237	.2102	.1730	.3737	.3435	.2276	.2127	.2823	.3239	.3027	.2272	.2159	.3716	.2789	.2650	.2594	.2146	.3037	.3327	.2762	792
	4/10	.1457	.1202	.2615	.2762	.2280	.1355	.1126	.1644	.3285	.2730	.1412	.1157	.2466	.2805	.2298	.1490	.1196	.3471	.2420	.1943	.1625	.1176	.2874	.2864	.2072	686
	8	.1495	.1270	.2499	.2827	.2417	.1399	.1197	.1554	.3371	.2883	.1444	.1227	.2339	.2882	.2449	.1506	.1265	.3293	.2482	.2085	.1657	.1244	.2722	.2947	.2213	802
	6	.1489	.1304	.2212	.2946	.2616	.1409	.1242	.1358	.3514	.3093	.1432	.1268	.2051	.3015	.2568	.1468	.1300	.2893	.2502	.2294	.1638	.1283	.2382	.3089	.2419	799
	4	.1389	.1278	.1805	.3106	.2857	.1352	.1235	.1099	.3685	.3343	.1362	.1252	.1982	.3185	.2928	.1369	.1273	.2352	.2741	.2549	.1556	.1263	.1927	.3269	.2667	793
	3/10	.0929	.0877	.2001	.2575	.1877	.0835	.0821	.1303	.3028	.2269	.0898	.0843	.1935	.2584	.1849	.0982	.0871	.2707	.2251	.1539	.1046	.0880	.2266	.2634	.1680	854
	8	.0877	.0713	.1517	.2821	.2296	.0820	.0674	.0982	.3338	.2746	.0950	.0689	.1439	.2855	.2313	.0893	.0708	.2022	.2464	.1955	.0980	.0702	.1679	.2916	.2068	791
	6	.0838	.0703	.1330	.2920	.2449	.0794	.0670	.0834	.3456	.2915	.0814	.0682	.1251	.2962	.2482	.0842	.0698	.1761	.2551	.2113	.0836	.0694	.1458	.3032	.2247	790
	4	.0809	.0707	.1170	.3012	.2632	.0779	.0678	.0722	.3576	.3111	.0788	.0688	.1088	.3074	.2684	.0804	.0702	.1536	.2644	.2308	.0804	.0699	.1264	.3152	.2438	794
	2/6	.0430	.0354	.0700	.2897	.2384	.0411	.0340	.0440	.3449	.2855	.0422	.0345	.0861	.2956	.2418	.0438	.0352	.0930	.2545	.2046	.0484	.0351	.0770	.3015	.2186	797
	4	.0442	.0375	.0704	.2963	.2466	.0423	.0359	.0437	.3471	.2945	.0433	.0366	.0856	.2973	.2510	.0447	.0374	.0928	.2556	.2138	.0496	.0372	.0766	.3038	.2276	878

* Spectrophotometric measurements on starred painting numbers were made by W. C. Granville (3); all others were made at the National Bureau of Standards.

TABLE II.—Tristimulus values and chromaticity coordinates of selected Munsell standards for five illuminants, in addition to four published J.O.S.A. July 1943, based on spectrophotometric data.—(continued).

Munsell notation	ICI B Illuminant					Fluorescent 3500K					Fluorescent 4500K					Fluorescent 6500K					Fluorescent Soft White					Munsell painting number
	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	X	Y	Z	x	y	
5P 9/2	.7435	.7209	.6729	.3479	.3373	.7571	.7167	.3995	.4041	.3828	.7351	.7167	.6083	.3569	.3479	.7113	.7171	.8639	.3103	.3129	.8296	.7216	.7015	.3683	.3203	2251*
8/4	.5334	.5037	.6401	.3392	.3180	.6376	.5842	.3796	.3981	.3648	.6231	.5866	.5787	.3484	.3280	.6082	.5896	.8224	.3011	.2919	.7093	.5948	.6680	.3597	.3016	284
2	.6040	.5897	.5567	.3451	.3369	.6154	.5847	.3297	.4023	.3822	.5981	.5859	.5024	.3546	.3474	.5792	.5876	.7138	.3080	.3124	.6748	.5899	.5793	.3660	.3199	282
7/6	.4956	.4392	.5206	.3420	.3011	.4942	.4287	.3112	.4004	.3474	.4839	.4300	.4734	.3488	.3100	.4744	.4322	.6720	.3005	.2738	.5590	.4413	.5474	.3612	.2851	1337
4	.4801	.4457	.4885	.3395	.3151	.4829	.4382	.2908	.3985	.3616	.4721	.4399	.4427	.3485	.3247	.4610	.4421	.6287	.3010	.2886	.5386	.4469	.5113	.3598	.2986	274
2	.4289	.4109	.4672	.3435	.3297	.4353	.4072	.2424	.4013	.3753	.4239	.4080	.3688	.3530	.3398	.4114	.4060	.5236	.3081	.3043	.4786	.4116	.4256	.3641	.3127	272
6/8	.3816	.3161	.4553	.3310	.2742	.3721	.3054	.2740	.3911	.3210	.3681	.3072	.4163	.3373	.2814	.3658	.3099	.5904	.2889	.2447	.4295	.3186	.4823	.3491	.2589	262
6	.3664	.3181	.4149	.3333	.2893	.3617	.3093	.2484	.3934	.3364	.3563	.3110	.3778	.3409	.2976	.3518	.3135	.5362	.2928	.2809	.4121	.3188	.4372	.3525	.2736	266
4	.3699	.3300	.3894	.3389	.3081	.3614	.3237	.2269	.3983	.3549	.3542	.3251	.3453	.3457	.3173	.3471	.3271	.4902	.2981	.2809	.4053	.3312	.3990	.3569	.2916	264
2	.3404	.3239	.3315	.3419	.3252	.3453	.3205	.1977	.3959	.3712	.3367	.3213	.3007	.3512	.3351	.3275	.3222	.4268	.3043	.2993	.3817	.3247	.3472	.3523	.3082	262
5/10	.2725	.2649	.3562	.3269	.3458	.2581	.1951	.2193	.3837	.3901	.2580	.1961	.3311	.3285	.3498	.2602	.1980	.4678	.2810	.2138	.3058	.2086	.3850	.3407	.2303	228
8	.2854	.2114	.3262	.3306	.2832	.2563	.2034	.1892	.3889	.3087	.2544	.2044	.3014	.3347	.2689	.2541	.2061	.4284	.2867	.2324	.2988	.2133	.3499	.3467	.2474	236
6	.2357	.1971	.2999	.3355	.2895	.2310	.1912	.1633	.3945	.3286	.2278	.1920	.2676	.3414	.2876	.2255	.1931	.3508	.2931	.2510	.2654	.1986	.2870	.3534	.2645	234
4	.2184	.1936	.2363	.3369	.2986	.2173	.1895	.1422	.3958	.3452	.2134	.1901	.2158	.3446	.3070	.2098	.1911	.3059	.2988	.2704	.2455	.1946	.2498	.3559	.2821	232
2	.2078	.1980	.2024	.3427	.3234	.2106	.1943	.1214	.4004	.3691	.2055	.1945	.1843	.3518	.3329	.2000	.1949	.2613	.3047	.2970	.2332	.1948	.2129	.3627	.3061	230
4/12	.1939	.1268	.2680	.3305	.2161	.1772	.1178	.1642	.3859	.2566	.1780	.1182	.2478	.3273	.2172	.1815	.1193	.3502	.2788	.1833	.2164	.1286	.2896	.3413	.2030	663
10	.1813	.1303	.2330	.3329	.2392	.1707	.1234	.1428	.3906	.2826	.1701	.1236	.2159	.3337	.2429	.1713	.1248	.3054	.2848	.2075	.2038	.1322	.2510	.3472	.2252	250
8	.1689	.1287	.2094	.3319	.2543	.1604	.1241	.1320	.3852	.2980	.1599	.1241	.1977	.3330	.2576	.1606	.1244	.2780	.2853	.2269	.1883	.1296	.2304	.3434	.2364	816
6	.1531	.1246	.1786	.3355	.2730	.1489	.1206	.1087	.3938	.3188	.1471	.1209	.1645	.3401	.2795	.1461	.1216	.2329	.2918	.2430	.1722	.1257	.1909	.3523	.2572	246
4	.1497	.1254	.1604	.3407	.2943	.1483	.1264	.0967	.3994	.3403	.1455	.1267	.1467	.3474	.3024	.1429	.1272	.2080	.2990	.2660	.1684	.1304	.1698	.3594	.2782	244
2	.1341	.1256	.1328	.3422	.3190	.1358	.1238	.0798	.4000	.3648	.1325	.1239	.1211	.3510	.3282	.1291	.1241	.1716	.3039	.2921	.1506	.1256	.1400	.3619	.3017	242
3/10	.1231	.0781	.1770	.3256	.2064	.1118	.0731	.1146	.3733	.2441	.1134	.0729	.1704	.3177	.2045	.1168	.0733	.2387	.2724	.1709	.1374	.0791	.1995	.3302	.1901	1319
8	.1032	.0766	.1467	.3264	.2310	.1016	.0730	.0923	.3806	.2735	.1020	.0730	.1385	.3254	.2330	.1036	.0734	.1949	.2786	.1974	.1217	.0776	.1615	.3373	.2151	290
6	.0953	.0748	.1263	.3283	.2499	.0937	.0719	.0787	.3835	.2944	.0936	.0721	.1184	.3295	.2537	.0943	.0724	.1689	.2826	.2172	.1104	.0755	.1378	.3409	.2332	286
4	.0874	.0708	.1030	.3345	.2711	.0849	.0688	.0634	.3911	.3169	.0840	.0689	.0956	.3381	.2771	.0836	.0691	.1351	.2905	.2402	.0981	.0714	.1111	.3496	.2545	284
2	.0819	.0738	.0836	.3424	.3083	.0820	.0727	.0504	.3998	.3545	.0802	.0728	.0764	.3497	.3172	.0784	.0729	.1083	.3022	.2807	.0919	.0742	.0884	.3611	.2915	282
2/6	.0498	.0350	.0671	.3278	.2307	.0466	.0338	.0443	.3738	.2712	.0476	.0336	.0654	.3217	.2303	.0479	.0336	.0912	.2774	.1943	.0557	.0354	.0767	.3330	.2112	306
4	.0459	.0360	.0564	.3320	.2605	.0444	.0351	.0359	.3844	.3042	.0442	.0350	.0536	.3325	.2637	.0443	.0350	.0753	.2864	.2386	.0516	.0364	.0626	.3428	.2415	1313
2	.0419	.0353	.0462	.3396	.2861	.0417	.0350	.0290	.3944	.3314	.0411	.0349	.0434	.3440	.2921	.0405	.0347	.0611	.2971	.2547	.0473	.0358	.0596	.3539	.2679	677
10P 8/4	.6561	.6201	.5920	.3512	.3319	.6658	.6164	.3532	.4071	.3769	.6462	.6154	.5372	.3592	.3421	.6251	.6144	.7622	.3123	.3089	.7332	.6224	.6201	.3711	.3150	810
7/8	.5554	.4786	.4839	.3659	.3153	.5592	.4752	.2910	.4219	.3586	.5403	.4718	.4417	.3717	.3245	.5207	.4683	.6280	.3224	.2900	.6263	.4873	.5108	.3866	.3000	1541
6	.5237	.4711	.4584	.3604	.3242	.5307	.4691	.2749	.4164	.3680	.5134	.4666	.4174	.3674	.3339	.4949	.4639	.5919	.3191	.2992	.5888	.4771	.4823	.3803	.3082	1540
4	.5127	.4688	.4461	.3591	.3284	.5215	.4678	.2673	.4150	.3723	.5044	.4654	.4060	.3687	.3383	.4886	.4627	.5756	.3188	.3035	.5757	.4741	.4689	.3791	.3121	1539
6/8	.4089	.3292	.3751	.3673	.2958	.4029	.3236	.2289	.4217	.3387	.3907	.3208	.3460	.3695	.3033	.3792	.3181	.4863	.3196	.2881	.4594	.3354	.4012	.3841	.2804	1538
6	.3959	.3345	.3546	.3649	.3083	.3954	.3310	.2145	.4203	.3518	.3829	.3285	.3250	.3694	.3169	.3702	.3280	.4803	.3201	.2819	.4453	.3401	.3763	.3833	.2928	1537
4	.3702	.3267	.3242	.3625	.3200	.3735	.3248	.1944	.4184	.3639	.3612	.3227	.2953	.3689	.3296	.3483	.3206	.4188	.3203	.2947	.4161	.3312	.3413	.3822	.3043	1536
5/10	.3264	.2289	.2846	.3886	.2726	.3149	.2227	.1761	.4412	.3120	.3038	.2188	.2652	.3856	.2777	.2941	.2152	.3743	.3328	.2435	.3681	.2372	.3064	.4029	.2596	1535
8	.2995	.2224	.2602	.3830	.2843	.2912	.2166	.1584	.4371	.3251	.2809	.2137	.2397	.3825	.2910	.2715	.2112	.3392	.3303	.2569	.3371	.2287	.2781	.3995	.2710	1534
6	.2761	.2170	.2358	.3788	.2977	.2736	.2144	.1438	.4331	.3394	.2638	.2116	.2174	.3808	.3054	.2542	.2087	.3075	.3300	.2709	.3118	.2230	.2521	.3963	.2834	1533
4	.2589	.2173	.2218	.3709	.3113	.2602	.2166	.1343	.4258	.3544	.2512	.2142	.2034	.3756	.3203	.2418	.2116	.2880	.3261	.2854	.0920	.2220	.2355	.3896	.2963	1532
4/10	.2110	.1377	.1922	.3900	.2547	.1990	.1325	.1216	.4393	.2924	.1928	.1297	.1830	.3822	.2571	.1881	.1273	.2558	.3293	.2229	.2365	.1429	.2122	.3997	.2415	1531
8	.2037	.1444	.1839	.3829	.2714	.1968	.1408	.1148	.4350	.3112	.1904	.1384	.1724	.3799	.2761	.1849	.1362	.2429	.3278	.2414	.2298	.1493	.2007	.3963	.2575	1530
6	.1905	.1438	.1692	.3784	.2856	.1877	.1420	.1051	.4316	.3266	.1814	.1398	.1580	.3786	.2917	.1755	.1376	.2228	.3275	.2567	.2156	.1484	.1837	.3936	.2710	1529
4	.1784	.1450	.1556	.3704	.3043	.1770	.1445	.0950	.4250	.3470	.1712	.1428	.1433	.3743	.3122	.1651	.1408	.2025	.3247	.2770	.1995	.1485	.1662	.3879	.2888	1528
3/10	.1118	.0673	.1191	.3750	.2256	.1027	.0633	.0777	.4205	.2611	.1009	.0634	.1153	.3622	.2239	.1005	.0613	.1612	.3111	.1898	.1248	.0696	.1351	.3787	.2113	1527
8	.1119	.0724	.1101	.3802	.2458	.1053	.0697	.0708	.4284	.2835	.1026	.0682	.1054	.3715	.2469	.1010	.0670	.1478	.3198	.2122	.1256	.0750	.1232	.3879	.2315	1526
6	.1028	.0738	.1026	.3676	.2646	.0990	.0720	.0649	.4196	.3053	.0966	.0710	.0971	.3650	.2663	.0948	.0701	.1364	.3145	.2328	.1157	.0760	.1132	.3796	.2492	1525
4	.0965	.0744	.0885	.3720	.2870	.0957	.0739	.0551	.4258	.3291	.0927	.0728	.0837	.3734	.2934	.0889	.0717	.1168	.3231	.2577	.1093	.0768	.0962	.3873	.2719	1524
2/6	.0583	.0387	.0531	.3635	.2420	.0554	.0378	.0416	.4109	.2807	.0545	.0371	.0614	.3561	.2423	.0541	.0363	.0857	.3089	.2063	.0657	.0401	.0720	.3699	.2254	1523
4	.0524	.0378	.0550	.3610	.2802	.0504	.0370	.0354	.4104	.3013	.0495	.0365	.0527	.3569	.2631	.0488	.0360	.0738	.3079	.2267	.0589	.0387	.0616	.3899	.2433	723
5RP 9/2	.7703	.7471	.6462	.3560	.3453	.7893	.7465	.3815	.4117	.3894	.7625	.7445	.5817	.3651	.3564	.7328	.7423	.8268	.3182	.3225	.8805	.7504	.6700	.3773	.3290	2860
8/6	.6569	.6109	.5107	.3694	.3435	.6759	.6135	.3021	.4247	.3855	.6492	.6090	.4604	.3777	.3544	.6192	.6038	.6541	.3299	.3217	.7396	.6203	.5305	.3912	.3281	1369
4	.6459	.6090	.5148	.3650	.3441	.6640	.6108	.3040	.4206	.3869	.6389	.6072	.4636	.3737	.3552	.6108	.6032	.6588	.3281	.3221	.7255	.6164	.5340	.3868	.3286	1368
2	.6661	.6463	.5380	.3600	.3493	.6859	.6481	.3179	.4152	.3923	.6611	.6454	.4846	.3691	.3604	.6331	.6423	.6885	.3224	.3270	.7455	.6506	.5581	.3815	.3330	1367
7/8	.5636	.4915	.4288	.3803	.3316	.5781	.4950	.2555	.4351	.3726	.5537	.4888	.3881	.3871	.3416	.5266	.4814	.5503	.3380	.3089	.6385	.5043	.4481	.4013	.3170	1366
6	.5634	.5017	.4298	.3769	.3356	.5785	.5053	.2566	.4316	.3770	.5546	.4995	.3900	.3840	.3459	.5280	.4928	.5533	.3354	.3130	.6365	.5128	.4502	.3990	.3206	1365
4	.5338	.4930	.4146	.3703	.3421	.5497	.4987	.2467	.4251	.3841	.5280	.4922	.3753	.3784	.3527	.5037	.4868	.5327	.3307	.3196	.6008	.5010	.4329	.3915	.3265	1364
2	.5011	.4758	.3997	.3640	.3456	.5165	.4787	.2376	.4189	.3883	.4972	.4755	.3615	.3727	.3564	.4755	.4716	.5132	.3256	.3229	.5623	.4810	.4168	.3851	.3295	1363
6/10	.4581	.3489	.3140	.4087	.3113	.4066	.3527	.1911	.4618	.3491	.4433	.3441	.2990	.4118	.3197	.4180	.3343	.4087	.3800	.2879	.5260	.3675	.3348	.4382	.2902	1362

* Spectrophotometric measurements on starred painting numbers were made by W. C. Granville (3); all others were made at the National Bureau of Standards.

References

1. Burnham, R. W.: "Comparison of Color Systems with Respect to Uniform Visual Spacing," *Journal of the Optical Society of America*, Vol. 39 (1949).

2. Evans, R. M.: *An Introduction to Color*, John Wiley & Sons, Inc., New York, N. Y. Chapman & Hall Ltd., London (1948).

3. Granville, W. C., Nickerson, D., and Foss, C. E.: "Trichromatic Specifications for Intermediate and Special Colors of the Munsell System," *Journal of the Optical Society of America*, Vol. 33 (1943).

4. Helson, H. and Jeffers, V. B.: "Fundamental Problems in Color Vision. II. Hue, Lightness, and Saturation of Selective Samples in Chromatic Illumination," *Journal of Experimental Psychology*, Vol. 26 (1940).

5. Judd, D. B.: "Hue, Saturation and Lightness of Surface Colors with Chromatic Illumination," *Journal of the Optical Society of America*, Vol. 30 (1940).

6. Kelly, K. L., Gibson, K. S., Nickerson, D.: "Tristimulus Specification of the Munsell *Book of Color* from Spectrophotometric Measurements," *Journal of the Optical Society of America*, Vol. 33 (1943). [U. S. National Bureau Standards Jour. Res. RP 1549.]

7. Knudsen, L. F.: "A Punch Card Technique to Obtain Coefficients of Orthogonal Polynomials," *Journal of the American Statistician Association*, Vol. 37 (1942).

8. Macbeth, N.: "Munsell Value Scales for Judging Reflectance," ILLUMINATING ENGINEERING, Vol. XLIV, 1949.

9. Newhall, S. M., Nickerson, D., and Judd, D. B.: "Final Report of the O.S.A. Subcommittee on the Spacing of the Munsell Colors," *Journal of the Optical Society of America*, Vol. 33 (1943).

10. Nickerson, D.: "Munsell Standard Colors Specified for Four Illuminants," ILLUMINATING ENGINEERING, Vol. XL (1945).

11. Nickerson, D.: "Spacing of the Munsell Colors," (a summary of the report of the O.S.A. sub-committee), ILLUMINATING ENGINEERING, Vol. XL (1945).

12. Nickerson, D.: "Munsell Renotations Used to Study Color Space of Hunter and Adams," *Journal of the Optical Society of America*, Vol. 40 (1950).

13. Pope, A.: *The Language of Drawing and Painting*, Harvard University Press (1949).

Technical Report Subscribers

Each year technical committees of the I.E.S. prepare for publication their reports on important findings on various phases of lighting and new recommended lighting practices. Since many members of the Society have use for every one of these reports in booklet form it has been authorized that a "report subscribers" system be set up in the Publications Office so that these members automatically receive a copy of each booklet immediately upon publication.

Requests for this service should be addressed directly to Publications Office, Illuminating Engineering Society, 51 Madison Ave., New York 10, N. Y.

TELECAST

LIGHTING NEWS OF CURRENT INTEREST

Summary of Action

Council Executive Committee

Cornell University, Ithaca, N. Y. was the meeting place July 12, 1950, for the I.E.S. Council Executive Committee. Present were C. H. Goddard, President; S. G. Hibben and Walter Sturrock, Vice Presidents; E. M. Strong, Treasurer; A. H. Manwaring, General Secretary; A. D. Hinckley, Technical Director; G. Ross Henninger, Editor; and E. C. Huerkamp, Chairman, Publications Committee.

Action on the election of new members is given in detail at the end of this Telecast Section.

Additional action taken by the Committee, on the Board of Examiners' recommendation, elected Frank A. Hansen to Member Emeritus grade in recognition of his many meritorious services to the Society.

The current membership totals are:

September 30, 1949		July 12, 1950
6883	Total Membership	7057
26	Members Emeritus	32*
44	Fellows	41
1521	Members	1610
5048	Associate Members	5005
244	Student Members	369

*Includes 8 Fellows of the Society

LOCAL ACTIVITIES

S. G. Hibben's report on this important phase of the Society's work included a report on next year's Regional Conference plans (see dates listed in Lighting Calendar, page 519), a possible Past-Chairman Award, and Section and Chapter activities.

Progress toward the establishment of new chapters was reported being made by groups in Mexico City, Tulsa, Oklahoma City, and Little Rock, Arkansas.

MEMBERSHIP CAMPAIGN WINNERS

Winners of the membership campaign, as reported for Garlan Morse, Chairman showed:

Total Membership

1st prize	$50.00	Quebec Chapter
2nd prize	$40.00	Oregon Section
3rd prize	$22.50	New Orleans Section

Member Grade Only

1st prize	$50.00	Western Michigan Chapter
2nd prize	$40.00	New Orleans Section
3rd prize	$22.50	Carolinas Chapter

NEW FELLOWS

Favorable letter ballot by members of Council was reported to the committee on the election of four new Fellows. Acceptance of the report elected to Fellow, the following distinguished members: Willard Allphin, Eugene W. Commery, James M. Ketch and Erwin F. Lowry. Details of their election are given in a separate item of this Telecast.

I.E.S. Editor Resigns

A. H. Manwaring, General Secretary, has announced the resignation of G. R. Henninger as Editor of the Society's Publications. Joining the Society's Headquarters staff in August, 1948, Mr. Henninger has taken a leading part in the development of the new format of ILLUMINATING ENGINEERING and the expanded publication program.

Beginning August first Miss Ruby Redford, Production Editor of ILLUMINATING ENGINEERING, has been appointed Acting Editor.

I.O.S. to Meet in U.S.A.

The International Organization for Standardization has accepted an invitation to hold its 1952 General Assembly in the United States. Delegates of the 29 countries that are members of the IOS will be guests of the American Standards Association. As U. S. member, the ASA presents the viewpoint of U. S. groups on standards that come before the IOS for international consideration. More than 100 national technical societies and associations and some 1700 leading industrial firms are ASA members.

Seventy one international technical committees are working to bring about agreement on definitions, terminology, specifications, dimensions, and test methods in the national standards of the member countries to increase understanding and easier interchange of products. Countries now members of the IOS are: Australia, Austria, Belgium, Brazil, Canada, Chile, Denmark, Finland, France, Hungary, India, Israel, Italy, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Switzerland, Sweden, Czechoslovakia, Union of South Africa, United Kingdom, Uruguay, United States of America, Union of Soviet Socialist Republics, Yugoslavia.

Seminars on Vision at Pacific University

Emphasizing the human aspects of occupational problems involving light and sight, a seminar on occupational vision was held on June 8-9 under the auspices of the newly organized Institute of Visual Sciences, Pacific University, Forest Grove, Oregon, cooperating with the Oregon Section of the Illuminating Engineering Society.

Illuminating engineers from the Pacific Northwest gathered with industrial physicians, ophthalmologists, optometrists and manufacturers' representatives to discuss current issues.

The meeting was highlighted by the presentation of Theron Fitch, illuminating engineer, Portland General Electric Company, delineating the general principles of occupational illumination. Mr. Fitch's material was forcefully illustrated by sound films demonstrating specific applications in the home, school and industry.

Other speakers included Dr. Richard Feinberg, chairman of the seminar, who enumerated the major forward steps which have been made in illuminating engineering, ophthalmology, optometry and safety engineering during the past decade and stressed the necessity for ever increasing cooperation among these professions. George Lewis, Safety Engineer, Portland Gas and Coke Company; R. A. Sherman, Manager of the Occupational Vision Department, Bausch and

Lomb Optical Company, Rochester, New York; and Mr. Walter J. Cornelius, Industrial Vision Consultant, American Optical Company, San Francisco, presented important materials dealing with industrial vision programs. Dr. Alfred J. Kreft, Portland physician and surgeon, Forrest E. Ricke, M.D., Industrial Physician, Portland, Oregon, and Harold M. Haynes, O.D. Assistant Professor in charge of visual training, College of Optometry, Pacific University, stressed the medical and optometric aspects of occupational vision.

Unity of the Engineering Profession

The group of representatives of large Engineering Societies, invited by Engineers Joint Council to explore the question of organization for increased unity of the engineering profession, had its second meeting on March 31, 1950. This group consists of the following 16 Engineering Societies:

Am. Soc. of Civil Engineers
Am. Inst. of Mining & Metall. Engrs.
Am. Soc. of Mechanical Engrs.
Am. Soc. of Electrical Engrs.
Am. Inst. of Chemical Engrs.
Am. Association of Engineers
Am. Soc. for Engineering Education
Am. Soc. of Htg. & Ventilating Engrs.
Am. Soc. of Refrigeration Engrs.
Am. Water Works Association
Illuminating Engineering Soc.
Inst. of Aeronautical Science
Inst. of Radio Engrs.
National Soc. of Professional Engrs.
Soc. of Automotive Engrs.
Soc. of Naval Architects & Marine Engrs.

Fourteen of the sixteen societies were represented at the meeting.

The major order of business was the consideration of the report of the Planning Committee of eight members which was appointed at the previous meeting of the Exploratory Group on October 20, 1949. The Planning Committee had been charged with the duty of studying and reporting back a discussion of various approaches which had been suggested to the question of organizing for increased unity.

The Planning Committee had held five meetings at which the wide range of subjects involved in the question at hand had been discussed. The report of the Committee submitted at this meeting included a discussion and comparative analysis of three possible approaches to the formation of a unity organization.

Recognizing that many approaches are possible the report of the Planning Committee included also suggestions as to a number of basic principles which were recommended to serve as a guide in any formation of a "unity organization" of engineers — this term being used to designate the organization through which increased unity of the engineering profession may be brought about, without in any sense proposing that this be adopted as a name of such an organization. The basic principles include the following:

The general aim of the unity organization will be to represent all engineers and engineering organizations who desire to be so represented in dealing with questions of interest to the profession as a whole. With this general aim in view, the following are proposed as basic principles to serve as a guide in determining the form of the unity organization and its relation to present engineering organizations.

1. The unity organization should include the affiliation of the major national engineering societies.

2. Affiliation should be open to all national engineering societies meeting certain general standards, on vote of the governing body.

As illustrative of the type of standards which may be established, it may be required that to qualify as an affiliate an engineering society should have a grade of membership with qualifications at least as high as those prescribed by the unity organization as necessary for professional recognition. Also, as a practical matter, affiliation may be limited to societies having more than a specified minimum number of members who are qualified engineers in accordance with this definition.

3. The unity organization should be formed by the modification and development of a present organization or organizations or by the integration of two or more present organizations rather than by the establishment of an entirely new organization.

4. The government of the unity organization should reside in a governing body on which all qualified engineering groups who wish to be associated with the organization are appropriately represented.

5. The activities of the unity organization should be determined by the governing body under the terms of a broad statement of general purposes in the constitution of the organization.

While a fairly complete statement of the general purpose of the organization should appear in its constitution, it does not appear useful to attempt to determine in advance what its specific activities would be at any given time. These would, no doubt, change from time to time in accordance with the wishes of the members.

LIGHTING CALENDAR

Society Events

August 21-24, 1950 — Southern California National Technical Conference, Hotel Huntington, Pasadena, Calif.

October 12, 1950 — Meeting of I.E.S. National Council, New York, N. Y.

October 26-27, 1950 — Northeastern Regional Conference, Hotel Statler, New York, N. Y.

March 4-6, 1951 — Southwestern Regional Conference, Corpus Christi, Texas.

March 13-16, 1951 — South Pacific Regional Conference, San Francisco, Calif.

March 19-24, 1951 — Pacific Northwest Regional Conference, Spokane, Wash.

April 9-10, 1951 — Southern Regional Conference, Miami, Fla.

May 9-12, 1951 — Canadian Regional Conference, Chateau Frontenac, Quebec.

May 14, 1951 — Midwestern Regional Conference (Hotel and City not yet announced).

May 21, 1951 — Great Lakes Regional Conference, Cincinnati, Ohio.

Industry Events

August 7-19, 1950 — First United States International Trade Fair, Chicago, Ill.

September 18-21, 1950 — International Municipal Signal Association, 55th Annual Convention, Hotel Commodore, New York, N. Y.

September 19-21, 1950 — The American Society of Mechanical Engineers, Fall Meeting, Hotel Sheraton, Worcester, Mass.

September 25-27, 1950 — National Electronics Conference, Chicago, Ill.

September 27-29, 1950 — Sixth annual meeting, Canadian Electrical Manufacturers Association, General Brock Hotel, Niagara Falls, Canada.

October 11-14, 1950 — International Association of Electrical Leagues, 15th Annual Conference, Copley Plaza, Boston, Mass.

October 11-14, 1950 — The Electrochemical Society Inc., 98th Meeting, Statler Hotel, Buffalo, N. Y.

October 16-20, 1950 — 38th National Safety Congress & Exposition of the National Safety Council, Chicago, Ill.

October 17-21, 1950 — National Electrical Contractors Association, Annual Convention, Hotel Biltmore, Los Angeles, Calif.

October 18-20, 1950 — National Farm Electrification Conference, Melbourne Hotel, St. Louis, Mo.

October 23-27, 1950 — American Institute for Electrical Engineers, Fall General Meeting, Skirvin Hotel, Oklahoma City, Okla.

November 13-16, 1950 — National Electrical Manufacturers Association, Chalfonte-Haddon Hall, Atlantic City, N. J.

November 28 - December 1, 1950 — The American Society of Mechanical Engineers, Annual Meeting, Hotel Statler, New York, N. Y.

November 27-29, 1950 — American Standards Association, Annual Meeting, Waldorf-Astoria Hotel, New York, N. Y.

December 3-6, 1950 — The American Society of Refrigerating Engineers, 46th Annual Meeting, Hotel Commodore, New York, N. Y.

January 22-26, 1951 — Winter General Meeting, American Institute of Electrical Engineers, New York.

March 12-15, 1951 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

April 2-5, 1951 — The American Society of Mechanical Engineers, Spring Meeting, Atlanta, Ga.

April 2-5, 1951 — 17th Annual Sales Conference, Edison Electric Institute, Edgewater Beach Hotel, Chicago, Ill.

June 4-7, 1951 — Edison Electric Institute, Denver, Colorado.

6. Within its field of activity, the unity organization should be authorized to deal directly with government agencies and others as a representative of the engineering profession.

For example, in such matters as the nomination of engineers to serve as members of committees and commissions, or the expression of opinions on public questions involving engineering, the unity organization should be empowered to act directly without a referendum of its constituents.

7. To the extent practicable, the unity organization should take over present cooperative activities of groups of national engineering societies, where such activities appropriately fall within the scope of the unity organization.

8. The unity organization should have its own offices and staff.

These principles were accepted by the Exploratory Group subject to such modifications as might be arrived at in further discussions. The report of the Planning Committee also presented a number of other questions requiring further consideration.

In the general discussion of the Exploratory Group, every member presented his views as to the type and form of "unity organization" which seemed most desirable and the means by which it might be brought about. The discussion centered about the three approaches to the form of organization included in the report of the Planning Committee. These three approaches would be as follows:

A. Expand and modify the present Engineers Joint Council so that the members of a larger number of engineering societies would be represented and so that representation would be, to some extent, in proportion to membership.

B. Expand and modify the present National Society of Professional Engineers with the understanding that the existing engineering societies cooperate by urging their members to join and by referring to that Society items of a broad general nature which the Society is in a position to handle.

C. Modify the National Society of Professional Engineers so that registration is not a requirement for individual membership, modify the Engineers Joint Council as in Item A, and combine the NSPE Board of Directors with the EJC to form a single governing body.

After a full discussion the entire matter of preparing a further comparison of possible plans and a consideration of the questions on which agreement had not been reached was referred to the Planning Committee for study. It is expected that the next report of the Planning Committee will be made to the Exploratory Group shortly after the summer vacation period.

Lighting Achievements Win Electrical Contractors Big Awards

For their achievements in the 1949 Cooperative Fall Lighting Campaign sponsored jointly by the Electrical Association of Philadelphia, and the Philadelphia Electric Company, eleven leading electrical contractors in that area were presented with big cash prizes in the amount of $700.00 recently. Awards were made at a regular meeting of the Philadelphia Section of I.E.S.

The prizes were furnished by five electrical contractor groups for outstanding work of their members in the Campaign. The five groups participating were: Contractors Division, and Bucks-Montgomery Section of the Electrical Association; Independent Electrical Contractors Association of Philadelphia; Penn-Del-Jersey Chapter of N.E.C.A.; and Delaware County Electrical Contractors Association. The campaign was conducted during September, October and November of 1949.

First prize went to Edward Abromeit, Philadelphia, who won $100 for his entry in the Commercial Lighting Classification. Second prize of $75 was presented to James C. Newborn, Spring City, and third prize of $50 to Edward B. Barber, Philadelphia. Three $25 prizes also for Commercial Lighting were given to Kinzer J. Baldwin, West Chester; Ralph D. Orr, Parkesburg; and Wilfred Stine, Philadelphia.

In the group of prizes awarded for Industrial Lighting, Ed Barber took first prize of $100. Louis W. Moxey, of Philadelphia, won the $75 second prize; George W. Wood, Media, Pa., won third

Special Ceremony Celebrates Charter Presentation of Mississippi Charter

The official I.E.S. Charter, formally inaugurating the Mississippi Chapter, was presented at a special Charter Night dinner June 23, held at the Heidelberg Hotel, Jackson, Miss. J. B. Browder, Southern Regional Vice-President made the presentation.

Principal speaker was Leonard A. Hobbs, a Director-Elect of I.E.S.

Growth and progressive activity in the new Chapter has already been demonstrated. In the few months from the time of its petition in December until the formal Charter night in June, membership has grown to 60, and a new Student Branch organized and installed. Programs and meetings for the coming year are already under way to bring the best in technical research and developments to the attention of the new Chapter's members.

Officers elected for the Mississippi Chapter are: Chairman, H. R. Chilton; Vice-Chairman, H. S. Thomas; Secretary-Treasurer, T. M. Salisbury. Messrs. W. R. Crockett, Harry Bourgeois, and B. M. Davis will serve as committee chairmen.

MISSISSIPPI CHAPTER Charter was presented by J. B. Browder (left), Regional Vice-President, June 23, to the new Chapter's Chairman, H. R. Chilton (center). Leonard A. Hobbs (right) was principal speaker at the Charter Night celebration.

ELECTRICAL CONTRACTORS who were awarded big cash prizes for achievements in the 1949 Cooperative Fall Lighting Campaign sponsored jointly by the Lighting Equipment Mfgs. Group, Electrical Association, and the Philadelphia Electric Co. Awards were made at a meeting of the Philadelphia Section of I.E.S. to: (usual order) Edward Abromeit, James C. Newborn, Edward B. Barber, Independent Wiring Co., K. J. Baldwin, Baldwin Electric Shop, Wilfred Stine, Sylvan W. Drucker, John A. Morrison, Louis W. Moxey, Keller-Pike Co., George W. Wood, Jack Adler, and George Neveler, Gehar Electric Co. Prizes were furnished by five electrical contractor groups. Rules of the contest were based on I.E.S. recommended practice.

prize of $50; and a $25 fourth prize was taken by Jack Adler of Philadelphia.

Two prizes were given for Exterior Lighting; a first of $100 and a second of $50. Top award was won by Harvey Nevler, and Jack Adler won the other.

Independent Wiring Co., Philadelphia, won the Electrical Association's special plaque awarded to the contracting firm for best cooperation.

Awards were presented by John A. Morrison, Managing Director of the Association, before an attendance of approximately 100.

A similar campaign is being planned for the fall of 1950 and contractors are again being encouraged to take part. The new campaign is expected to start off September 11, 1950.

Decrease in Night Traffic Deaths Reported

Fatal night traffic accidents have been completely eliminated on thoroughfares in 11 cities where modern street lighting has been installed, according to reports by Street and Traffic Safety Lighting Bureau.

The cities included in the report on lighting improvements are: Beverly Hills, Calif.—mile-long, heavily traveled street; Darby, Pa.—six intersections; Hayward, Calif.—main highway leading into city; Plymouth, Mass.—main street; San Antonio, Tex.—1.3 miles of thoroughfare; San Bernardino, Calif.—main thoroughfare; Seattle, Wash.—2.8 miles of main thoroughfare; Stamford Conn. —virtually all city street lights; Utica, N. Y.—1.6-mile main thoroughfare; Waterbury, Conn.—main streets.

Seven other cities reported night fatality reductions of 65 to 93 per cent on thoroughfares which have been relighted —Hartford, Conn.—31 miles of streets; Grand Rapids, Mich.—four-mile stretch of road leading into city; Houston, Tex. —4.3 miles of main thoroughfare; Kansas City, Mo.—various streets; Los Angeles, Calif.—20 intersections; Salt Lake City, Utah—3-mile stretch of highway entering city; Bridgeport, Conn.—main thoroughfares. Ten thousand lives could be saved annually, the Bureau estimates, by reducing fatal night crashes only 59 per cent.

"South Pacific" Tickets for Regional Conference Delegates

The New York Section planners of the Northeastern Regional Conference, to be held in New York October 26 and 27, have obtained 100 tickets to "South Pacific," and an additional 100 tickets to other Broadway plays.

These "precious paste-boards," good for those dates, will be made available to members attending the Conference.

Pacific Coast papers please copy.

Illumination Feature of Ohio State Educational Conference

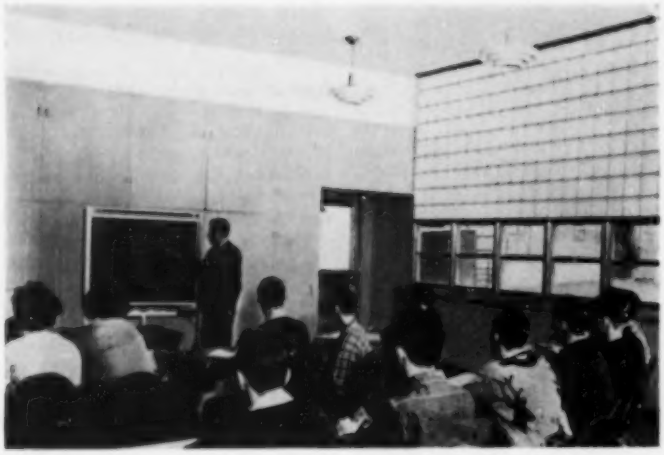
Almost the entire session of the two-day Educational Conference held May 14-15 at Ohio State University, was devoted to vision and illumination, especially as related to school and industrial environment. Among other prominent speakers at the Conference was C. L. Crouch, Technical Director of I.E.S. Mr. Crouch participated in two of the sessions on May 15, discussing "Lighting for Schools and Industry," and "Prescribing Illumination." The complete program of this important Conference included:

Dr. Glenn A. Fry—"Problems Related to Eye Dominance"
Dr. Thomas E. Shaffer—"Patterns of Child Development"
Dr. Leland Jacobs—"What Happens When a Child Reads"
Dr. Franklin M. Foote—"Progress in Sight Conservation"
Mr. C. L. Crouch—"Lighting for Schools and Industry"
Dr. Paul Fitts—"Eye Fixations of Aircraft Pilots"
Mr. Charles Stewart—"School Survey Techniques"
Mr. C. L. Crouch—"Prescribing Illumination"
Dr. V. J. Ellerbrock—"Recent Developments in the Field of Subnormal Vision"

Daylighting Research Center Established

The construction of an experimental classroom building, said to be the only one of its kind, has recently been completed at Port Allegany, Pa., by the Pittsburgh Corning Corp. Designed in accordance with the newest schoolhouse construction practices, the daylighting research center expects to serve as an experimental station for the testing of glass block fenestration performance, and the general development of the coordinated classroom. Comparison tests of various glass block patterns are expedited in the experimental school since, the construction allows certain blocks to be removed by masons within half an hour.

Dr. A. H. Baker, Pittsburgh Corning's



Students and teacher from the Port Allegany, Pa. High School test daylighting facilities in the demonstration classroom of the recently established Daylighting Research Center there.

Research Chief, said about the new classroom, "The experimental classroom will speed the completion of many of our daylight researches. For example, we are at the moment studying various inexpensive ways of providing brightness control at the vision strip. Soon we will investigate the relationship between classroom illumination and visual aids projection."

By way of extending an invitation to interested observers to visit Pittsburgh Corning's Daylighting Research Center, Dr. Baker commented, "We expect the demonstration classroom will be of great interest and assistance to architects and school administrators who wish to investigate new design ideas."

Lighting Course Students Form Club

A well organized Lighting Club in Chicago, Illinois has been functioning for about three years now, formed by graduates of lighting courses of the Chicago Lighting Institute.

Its purpose is the mutual discussion of illuminating engineering and all associated aspects of that field. Dinner meetings are held on the Third Wednesday of each month in an informal atmosphere of good fellowship. The evening's program may consist of a talk by an outside speaker, or a member of the club, followed by a roundtable discussion, or the entire meeting may be given over to a "bull session" in which no holds are barred, and everyone has a chance to express himself.

Field trips are occasionally scheduled, also; the group recently visited the new I.B.T. No. 2 Toll Building, and has made an airplane trip to Indianapolis airport, to inspect the lighting facilities there.

Attendance at meetings is limited to members and their guests, in order to keep the group small enough for informality. The membership is aimed at including representatives of various interested fields, and at present the enterprises represented are: Architects, 3; Cold Cathode Mfrs., 2; Consulting Engineers, 2; Designers, 3; Electrical Contractors, 1; Electric Utilities, 3; Fixture Mfrs., 5; Glass Mfrs., 1; Lamp Mfrs., 1; Wholesalers, 2; Users, 2.

Present officers of the Chicago Lighting Club are: Arthur P. Larson, Chairman; Brice E. Gilman, Vice Chairman; Kenneth E. Holmes, Secretary; and Clarence Clarkson, Treasurer. Maurice B. Cook is Program Chairman.

"Go West (Pasadena) Young Man"

"Go West Young Man" was the theme of a skit presented before the Chicago Section of the Illuminating Engineering Society to promote attendance at the National Technical Conference in Pasadena, California, August 21-24.

A short talk by Clarence W. Clarkson, who arranged the program emphasized that this was an unusual opportunity to combine a vacation for the whole family with attendance at a top flight technical conference. Clarkson offered to furnish maps and other data to those who plan to drive.

His talk was followed by a sound-color film of Southern California, after which Misses Irene Bonk and Lorraine Dietz distributed oranges flown from California for the occasion.

Four New Fellows

Action of the Council Executive Committee July 12 on favorable letter ballot of Council resulted in the election to Fellow grade of four distinguished members of the Society. The Society's four new Fellows are: Eugene Commery—Executive Engineer in charge of Residential Lighting, General Electric Co., Nela Park, East Cleveland, Ohio. Mr. Commery, a graduate of Case School of Applied Science, has been active in illuminating engineering for 28 years. Although prominently identified with residential lighting activities, he has been responsible for the design of many outstanding lighting installations in churches, studios and offices.

The Transactions of the Society record a long list of his technical papers. He has been prominently identified with portable lamp certification and industry specifications for residential luminaires.

Mr. Commery's services to the Society include many committee assignments, one, on the Residential Lighting Committee extending unbroken for 20 years.

Willard Allphin—Supervisor in the Commercial Engineering Department, Sylvania Electric Products, Inc., Ipswich, Mass. Mr. Allphin has been active in the field of illuminating engineering for 18 years. A graduate of the Massachusetts Institute of Technology, he is a registered professional engineer in the State of Massachusetts. His activities have taken two broad channels. One is in school lighting, particularly on the relationship between lighting and learning. The other is in the field of investigation of the physiological cost of seeing. A number of his papers have been published in ILLUMINATING ENGINEERING, *American School Board Journal*, *Electrical World*, and elsewhere. He has served and is currently serving on a number of important committees of the Society.

James M. Ketch—Illuminating Engineer, General Electric Co., Nela Park, East Cleveland, Ohio. A graduate of the University of Illinois, Mr. Ketch has been engaged in illuminating engineering

Willard Allphin

Eugene Commery

James M. Ketch

Edwin F. Lowry

for 33 years. His lighting activities have been most extensive, ranging from industrial lighting practice through office, school and public building lighting. A number of important technical papers dealing with depreciation of lighting equipment; special lighting applications for industry; and engineering aspects of direct lighting have been published in the Transactions under Mr. Ketch's sole, or joint authorship.

He is widely known throughout the industry for his work in training programs for the young men entering the lighting field. His activities in many widely scattered sections of the country have resulted in the formation of many now active Chapters and Sections of the Society. He has served on many Society committees and as an officer and member of Council.

Edwin F. Lowry—Manager of Fluorescent Lighting, Sylvania Electric Products, Inc., Salem, Mass. Dr. Lowry's principal activity in the lighting field has been in research dealing with developments and improvements of gaseous discharge lamps. The holder of degrees in chemistry and including a Ph.D. in physics, Dr. Lowry taught this subject for 7 years before entering industry in a research capacity. Twenty-two patents dealing with gaseous discharge lamps are credited to him. In a practical way these have contributed to longer life, improved appearance and greater efficiency of fluorescent lamps.

Dr. Lowry's technical papers have appeared in ILLUMINATING ENGINEERING, *Physical Review*, *Electronics*, *Review of Scientific Instruments* and elsewhere. He served as Secretary-Treasurer of the electronics division of the Electro-chemical Society, and helped to organize and lead a symposium on Luminescence at Ohio State University in 1946.

OBITUARY

E. J. Dailey

E. J. Dailey, until recent years an active member of I.E.S., died at his home in Pelham Manor, N. Y. June 20. He was sixty-two.

Manager of the Power Apparatus Sales for Graybar Electric Co., Mr. Dailey was for many years an important leader of society activities, in the New York Section, particularly. He served as manager of the Section in 1926-27, and was a Chairman of the Publications Committee, and the Board of Examiners, as well as serving as a member of many national committees.

Alexander D. Cameron

Alexander D. Cameron, Past-President of I.E.S. and retired Vice-President of Holophane Company, Inc., died May 25th at his winter home, Sarasota, Fla. He was sixty years of age.

Mr. Cameron's career in the lighting field, distinguished for outstanding technical attainments and exceptional managerial ability, began after his graduation from Penn State in 1910 where he had studied Electrical Engineering. At this time he became affiliated with the Street Lighting Department of the General Electric Company, ultimately becoming manager.

In 1931, Mr. Cameron started his long affiliation with the Holophane Company, Inc., which led to his appointment as Vice-President and as a member of the Board of Directors of the company. His retirement from business in 1946 terminated this successful association.

The same technical and executive abilities which brought him to prominence in his industrial career, made Mr. Cameron an invaluable member of I.E.S. From the time he became a full member in 1935 and accepted increasing responsibilities in the Society, his friendly advice and keen business judgment were eagerly sought by his associates on the Council. He served a three year term as General Secretary from 1935-1938, was Vice-President from 1938-1940, and President of the Society for the term 1940-1941. Mr. Cameron was past-Chairman of the Committee on Membership, the Committee on Local Activities, the Finance Committee besides being a member of many other committees. Recognition of his outstanding services to the Society was afforded in his election to the grade of Member Emeritus in 1946.

During World War I Mr. Cameron was Executive Officer in the Radio Division

A. D. Cameron

of the Signal Corps and saw extended service in this country and in France. He was discharged as a Major in the Reserve Corps.

Surviving are his wife, Mrs. Eva Cameron, and two sons, Alexander and Bruce Cameron.

About People

G. Ross Henninger

G. Ross Henninger, formerly editor of ILLUMINATING ENGINEERING, has been appointed Professor in the Extension Department of the Engineering Division, Iowa State College, Ames, Iowa. In his new position, Mr. Henninger expects to do both teaching and administrative work.

Mr. Henninger was graduated in 1922 from the University of Southern California, Los Angeles with a B.S. in electrical engineering. During his early career he was associated with The Southern California Edison Co. and the Westinghouse Electric Corp., at East Pittsburgh, and in 1924 he became editor of the *Journal of Electricity*. Prior to his association with ILLUMINATING ENGINEERING, he was for eighteen years editor of *Electrical Engineering*, the journal of the American Institute of Electrical Engineers.

Mr. Henninger is a registered professional engineer in the State of New York, a Fellow of the A.I.E.E. and a member of the I.E.S. and A.S.E.E.

George O. Hodgson is retiring from his position of manager of the Rocky Mountain Sales District of General Electric Co., after having completed 41 years of continuous service with the company, according to a recent announcement by Fred F. Harroff, vice-president and department general manager.

Dr. M. E. Bitterman, until recently associate professor of psychology at Cornell University, writes that in January he came to the University of Texas where he is a professor of psychology. He adds "we're in the process of constructing a magnificent new psychological laboratory" ... where "there will be excellent facilities for lighting research—**Read Granberry** saw to that."

Dr. Ward Harrison has been signally honored by the Illuminating Engineering Society of Great Britain in his recent election by the council as Honorary Member of the society. Where honorary members are limited to not more than six, such recognition for outstanding contributions to illuminating engineering is especially valued.

David L. Williams, a Bausch & Lomb Optical Co. engineer for the past 12 years, has joined the Westinghouse Lamp Division, Ralph R. Brady, manager of commercial engineering, announced recently. Mr. Williams will specialize in reflection systems such as those used in automotive and locomotive headlights, and lighting for motion picture projectors.

Walter H. Garrett, Jr. has been appointed district lamp engineer by Westinghouse Lamp Division's eastern district.

A. Dexter Hinckley, executive secretary of the I.E.S., has been elected the twenty-ninth president of the Columbia University Engineering School Alumni Association, it was recently announced.

Horace B. Finney has been appointed district lamp engineer for Westinghouse, according to an announcement made by George H. MacGilvray, New England District lamp manager.

Iowa State College Alumni Association awarded "the highest honor which the Association can bestow" to **Dr. Matthew Luckiesh** when it nominated him for the Alumni Merit Award for 1950. This was presented to Dr. Luckiesh at a special alumni program at Ames, Iowa on June 10th.

The appointment of **Don Drell** and **Bill Fraser** as Michigan representatives for Leader Electric Co., was announced recently by Walter Glass, president of the company.

The Washington Water Power Co., Spokane, Wash., was presented the General Electric Company's Charles A. Coffin award for outstanding achievement during 1949, at the Edison Electric Institute's annual convention held recently in Atlantic City.

Earl C. Bruckmann has been appointed supervisor of the Westinghouse lamp life test department at Bloomfield, N. J.

Robert S. Bostwick has been recently appointed manager of Western Division of Florida Power and Light Co. with headquarters at Sarasota, Fla.

The election of **Dr. Robert Calvert** of New York City as the 1950-51 president of the Technical Societies Council of New York, Inc., was announced recently.

Arthur W. Willmann, formerly with the General Electric Lamp Dept. in New York, has recently become associated with the New York representative of the Gill Glass and Fixture Co.; while **R. H. Gray** has been appointed representative for this company in the Dayton-Cincinnati, Ohio area, with headquarters in Dayton.

W. G. Peirce, Jr., president, Peirce-Phelps, Inc., Philadelphia, was elected president of the National Association of Electrical Distributors following the general session June 14 of the Association's 42nd Annual Convention being held at Convention Hall, Atlantic City.

Also announced at the close of the luncheon and organization meeting of the Board of Governors was the election of **Benjamin Gross**, Gross Distributors, New York, as vice-president and chairman of the Appliance Division. **R. M. Johannesen**, Johannesen Electric Co., Greensboro, N. C., was re-elected vice-president and chairman of the Apparatus and Supply Division. **I. W. Danforth**, Danforth Co., Pittsburgh, was elected to the executive committee and **Ralph Brown**, General Electric Supply Corp., Bridgeport was re-elected to that committee.

Hugh M. Nazor has been appointed vice-president in charge of sales of the Smitheraft Lighting Division, A. L. Smith Iron Co., Chelsea, Mass.

A new Westinghouse Lamp Division branch office has been established in Des Moines, Iowa under **Rolland L. Rasmussen**. Before joining Westinghouse recently, Mr. Rasmussen had been active in the electrical construction business and in the sales and pro-

motion of electrical devices at the distributor level; the last two years as a member of the Crescent Electric Supply Company staff in Sioux City.

Mr. Henri Maisonneuve, a progressive leader in the lighting field in France and a long time member of the I.E.S. has been recognized and honored by the Society in his recent election to the grade of Member Emeritus. Although necessarily not able to participate in Society affairs here, Mr. Maisonneuve's contributions to illuminating engineering have exerted so significant an influence on lighting practices on the Continent, that the I.E.S. has indirectly felt itself benefited. His attendance at I.E.S. National Conventions and sessions of the I.C.I. have resulted in a valuable exchange of lighting knowledge between the Continents. During his active career as head of a Lighting Department of the Compagnie des Lampes, the numerous installations which he conceived and designed established him as a leader in the industry. At the company Headquarters, with the encouragement of the late Alvin Powell he founded and developed the first lighting institute and school in Paris and under his direction this institute has promoted substantially better lighting practice.

Dr. Matthew Luckiesh, recently retired director of the General Electric Lighting Research Laboratory at Nela Park, Cleveland was again honored by the Society when the Council Executive Committee elected him to grade of Member Emeritus at their June 8th meeting. Previous recognition for his valuable contributions to research in the fields of illumination and vision had been afforded Dr. Luckiesh by his election to Fellow of I.E.S. (1925-1926) and the award of I.E.S. Gold Medal in 1947, the Society's highest honor.

Robert Burton, Sr., of Oak Park, Ill., although retired from active practice in the lighting field, has maintained active participation in I.E.S. interests. He has made contributions of Society publications to the Oak Park Public Library and to the service library of the Chicago Lighting Institute, and maintains constant correspondence contact with I.E.S. National officers.

George Munson, former magazine and advertising photographer, has joined Westinghouse as a photolamp specialist, it was recently announced. Mr. Munson will travel through New York state and northern New Jersey guiding customers on the best photographic lighting techniques, including selection of the proper lamps.

Charles H. Goddard, I.E.S. President, will assume responsibility for National Accounts sales in the Lighting Division of Sylvania Electric Products Inc., it was announced recently. Mr. Goddard will also continue in his present capacity as Manager of Utility Sales.

The appointment of **Ira G. Deitrick** to succeed **George H. MacGilvray** as manager of the New England District, Westinghouse Lamp Division, has been announced. Mr. MacGilvray retired July 1 after thirty-six years of service with Westinghouse in New England.

Julius Daniels, I.E.S. President in 1931-1932, has returned to the Boston Edison Co. after several years in the paraplegic ward of the Cushing Veterans' Hospital, Boston. Given up as a hopeless paraplegic after a spinal injury some years ago, Mr. Daniels now heads the New Business Section of Boston Edison, under his own power, with two canes.

Having discovered that there were no centers comparable to the Veterans hospitals for the treatment of civilian paraplegics (with the exception of Bellevue Hospital in New York and one small expensive place in Virginia), Mr. Daniels and other paraplegic veterans have set up a national fund to build and equip civilian paraplegic wards in hospitals near great medical centers.

IT SEEMS TO ME

Architecture of Light

To the Editor:

I have read with very much attention, in the last number of May of ILLUMINATING ENGINEERING, your article concerning the "Architecture of Light."

Thank you, Mr. Crouch, for your work which summarizes very well a technical, social and spiritual problem, and therefore deeply humane one.

Reading your writing, I have remembered Goethe, great universal spirit, poet, philosopher and scientist.

When 150 years ago, he wrote that long and meditated scientific work, *The Theory of Colours,* a friend of his wished to inquire into the cause that had induced him to write such a masterpiece; Goethe synthetized the reply with the famous phrase: "Because only light is life"; and your article has looked to me a completion of that reply.

Trusting to read from you again, I remain, G. ORECCHIA, *Associate Member I.E.S., Torino, Italy.*

Polarized Headlamps

To the Editor:

In the June, 1950 issue (page 386), D. M. Finch offers some objections to polarized headlamps for vehicles. One statement regarding "the loss of warning halo on curves and hills" is frequently heard.

This halo is of value chiefly to drivers intending to pass on hills and curves. It seems strange to reject an otherwise preferable system because it handicaps those engaged in unwise, and in some states, illegal practices. But if halo is desired, raising the windshield viewing screen will make it visible.

The "Impracticability of using the system on small vehicles—" is not obvious to this cyclist. We have found polaroid screens clipped to the upper half of spectacle frames offers full protection from polaroid headlamps without loss of visibility of the road close ahead. The result is far better than the present condition where very few lights are dimmed for cyclists and pedestrians.

Further, "the interim period during change over to the polarized system would also pose many problems for—"! The existing lights also pose many problems including fatal accidents.—CHARLES R. MARSH, *Pennsylvania State College, School of Engineering, State College, Pennsylvania.*

"Sold Down the River"

To the Editor:

Here is a little more information to keep the pot boiling on the Winkler-Neidhart-Gores dispute. The following paragraph is quoted from *Light and Lighting,* the English publication, page 200, May, 1950.

"In a recent edition of the American publication ILLUMINATING ENGINEERING, the authors of a paper in their reply to the discussion 'offer their apologies to . . . if he believes that we have sold quality lighting down the river.' Having seen American films I know that the expression 'up the river' refers to some penal institution; but what is there down the river to be ashamed of? There is probably quality lighting at the former place, so why not downstream as well?"—T. D. WAKEFIELD, *Vice-President, F. W. Wakefield Brass Company, Vermilion, Ohio.*

EDITOR'S NOTE: For the benefit of our British readers, "sold down the river" is American vernacular for "sold out, personally." Before the emancipation of Negro slaves in 1865, slaves to be sold out of a family were sent down the Mississippi River to the slave markets of New Orleans. Since they frequently felt affiliated with the families into which they were born, being "sold down the river" had a connotation of betrayal.

Why 30 Footcandles?

To the Editor:

Two articles in the June IE seem to express a different philosophy in regard to recommended levels of lighting.

In the discussion by Mr. Crouch (page 344), the sentence "lighting should be designed for the most difficult task commonly found" seems to express a prevailing opinion. It recognizes that extra footcandles within any reasonable range do not adversely affect vision for the keener eye and the easier task, whereas a minimum level must be provided for the more difficult task and average eye.

This seems to be at variance to the recommendations of Miss Webber and Mr. Commery for the lighting of piano scores (page 348). The difference does not stem from the recommendation of certain footcandles for a given score but from the assumption that individual measurements can be directly applied to a general visual activity. An extreme interpretation of this thinking would demand an extra foot pedal to control the lighting as one reached a hard or easy passage.

... Three aspects of this study are not matched by I.E.S. recommendations in other fields. They are:

1. That mental grade is related directly to the grade of visual severity.
2. That at any one piano, only a certain grade of music is played.
3. That a given student advances so slowly that the lighting can be specifically designed for each step of his development.

An illustration of the first point may be helpful. The average hymn represents music of an elementary or at the most intermediate grade. Yet it is easy to find samples of such music printed on paper of poor contrast and so crowded that it represents a difficult visual task. I would suggest Liszt's "Liebestraum" as a good example of the reverse.

Good engineering evolves from broad and comprehensive studies of details. But in so doing it recognizes and interprets these studies into application techniques that are equally broad and comprehensive.—R. G. SLAUER, *Sylvania Electric Products, Inc., Salem, Mass.*

NEW MEMBERS

At the meeting of the Council Executive Committee held in Ithaca, N. Y., on July 12, 1950, the following were elected to membership:

ALAMO CHAPTER

Associate Member:
Scott, H. L., Scott Elec. Co., Corpus Christi, Tex.

BRITISH COLUMBIA SECTION

Associate Members:
Edwards, J. S., 1084 Homer St., Vancouver, B. C.
McLaren, H. A., Wholesale Elec. Ltd., Vancouver, B. C.

CENTRAL NEW YORK CHAPTER

Member:
Acheson, C. R., 306 W. Genesee St., Syracuse
Associate Member:
Kulow, R. C., H. D. Kulow Electric Co., Utica

One of the two tubes of the Brooklyn-Battery Tunnel, turned on officially May 25, showing a portion of the longest continuous lighting installation in the world. Extending almost two miles, the four ribbons of uninterrupted light include 5,776 individual fluorescent lamps and almost 3,000 ballasts. The unique system is part of the extensive electrical equipment supplied for the new link between Brooklyn and lower Manhattan. Temporary construction lights on the ceiling are to be removed. Technical and other details of the installation is the subject of a paper by Leo Geenens and Kirk M. Reid being presented before the I.E.S. National Technical Conference.

CAROLINAS CHAPTER

Member:
Harris, W. B., Ivy H. Smith Co., Greensboro, N. C.
Associate Members:
Horney, V. V., Ivy H. Smith Co., Greensboro, N. C.
McCormack, C. J., Westinghouse Elec. Corp., Charlotte, N. C.
Wicker, J. F., 215A E. Washington St., Greensboro, N. C.

CHICAGO SECTION

Associate Members:
Burnham, R. D., Chicago Lighting Institute, Chicago
Butter, M. L., Triangle Industries, Inc., Chicago
Student Member:
Underwood, J. D., University of Illinois, Urbana, Ill.

CLEVELAND SECTION

Member:
Rodgers, Allston, General Electric Co., Cleveland
Associate Members:
Clark, C. N., General Electric Co., Cleveland.
Coakley, Rose M. (Miss), The Toledo Edison Co., Toledo
Schultz, H. E., General Electric Co., Cleveland

CONNECTICUT SECTION

Associate Member:
Pokrop, P. C., Conn. Light & Power Co., New Britain

EASTERN PENNSYLVANIA CHAPTER

Associate Members:
Carbutt, J. E., Westinghouse Elec. Supply Co., Reading
Crouse, H. H., H. H. Crouse Planing Mill & Builders Supplies, Hanover
Yost, G. C., Graybar Elec. Co., Inc., Reading

HEART OF AMERICA SECTION

Associate Members:
Bestingue, H. J., Kansas Gas & Elec. Co., Eldorado, Kans.
Hegler, B. E., Kansas Gas & Elec. Co., Arkansas City, Kans.

INDIANA CHAPTER

Member:
Crockett, R. E., General Elec. Co., Indianapolis

MICHIGAN SECTION

Member:
Sawer, H. A., The Detroit Edison Co., Detroit
Associate Members:
Bachman, John, Smith Bros. Elec. Inc., Detroit
Jackson, C. R., Westinghouse Elec. Supply Co., Detroit

MILWAUKEE CHAPTER

Member:
Manning, R. A., Moe-Bridges Corp., Sheboygan, Wis.
Associate Members:
Lessenich, L. J., Wisconsin Elec. Power Co., Milwaukee
Mahar, J. F., Wisconsin Elec. Power Co., Milwaukee
Student Member:
Leister, T. H., University of Wisconsin, Madison

MISSISSIPPI CHAPTER

Associate Members:
Hegwood, H. G., Stuart C. Irby Co., Jackson
Smith, F. G., Jr., Miss. Power & Light Co., Greenville
Student Member:
Idiaquez, J. T., Jr., Miss. State College, State College

MONTREAL SECTION

Associate Members:
Jedrychowski, J. L., Beaconing Optical & Precision Materials Co. Ltd., Granby, Que.
Langlands, J. S., The British General Electric Co., Montreal
Mac Laine, R. H. Patterson Electric (Eastern) Ltd., Montreal
Taylor, T. A. I. C., Patterson Electric (Eastern) Ltd., Montreal

NEW ORLEANS SECTION

Associate Members:
Brothers, L. L., Brothers Electric, New Orleans
Frank, W. L., Lighting Fixture & Electrical Supply Co., New Orleans

Continued on page 11A

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WALTER STURROCK—Vice-President
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THEODORE H. SHEPHERD—South Pacific Coast Region
FLOYD A. COVINGTON—Southwestern Region

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Southern Region

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South Pacific Coast Region

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Southwestern Region

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Southern Region

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SECRETARY — SAMUEL B. LaCORNU, Nashville Electric Service Co., 605 Church St., Nashville 3, Tenn.

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South Pacific Coast Region

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SECRETARY — CLARENCE J. VACHER, General Electric Supply Co., Box 1919, Salt Lake City, Utah

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Great Lakes Region

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SECRETARY—J. W. McKINLEY, 820 Rosewood Ave., Grand Rapids 6, Mich.

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Great Lakes Region

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SECRETARY—WILLIAM A. BISER, General Electric Co., 535 Washington St., Buffalo 3, N. Y.

Winnipeg Chapter—Canadian Region

CHAIRMAN—EDMUND F. WILSON, 196 Balmoral St., Winnipeg, Man., Can.

SECRETARY—T. W. BIRT, Winnipeg Electric Co., Electric Railway Chambers, Winnipeg, Man., Can.

COMMITTEES

COMMITTEES
1949-1950

Except as noted below, all committees are appointed by the President, subject to approval of the Council, and terminate at the time of the first Council meeting each new administration, in the month of October. The duties of each committee are indicated.

C. H. Goddard, President, ex-officio member of all committees.

STANDING COMMITTEES

BOARD OF FELLOWS — To evaluate the eligibility of candidates for transfer to the grade of Fellow and recommend their election by Council.

Howard M. Sharp, Chairman, 82 Smallwood Drive, Synder 21, New York

O. P. Cleaver	H. H. Magdsick
W. Harrison	T. W. Rolph

J. L. Stair

COUNCIL EXECUTIVE — To conduct the affairs of the Society between Council meetings.

C. H. Goddard, Chairman, Sylvania Elec. Prods. Inc., 60 Boston St., Salem, Mass.

S. G. Hibben	E. M. Strong
A. H. Manwaring	Walter Sturrock

FINANCE — Direct supervision of the financial affairs of the Society, present annual report on its financial condition and make recommendations to Council as to investments of money and upon all specific appropriations.

C. C. Keller, Chairman, Holophane Co., Inc., 342 Madison Ave., New York 17, N. Y.

G. T. Bogard	E. M. Strong

M. N. Waterman

GENERAL BOARD OF EXAMINERS — Evaluate the eligibility of applicants for admission to membership or transfer to the grade of Member and submit to Council their nominees for election to the grade of Member Emeritus.

E. M. Fahey, Chairman, Public Service Elec. & Gas Co., 80 Park Place, Newark 1, N. J.

B. C. Cooper	Caroline Horn

PAPERS — To procure, review and approve all technical papers and discusions thereof, for presentation before National Conferences of the Society.

Hoyt P. Steele, Chairman, Benjamin Electric Mfg. Co., Des Plaines, Ill.

H. W. Horn, Vice-Chairman, University of Illinois, Urbana, Ill.

R. D. Bradley	K. M. Reid
C. I. Brady	H. L. Wright
P. H. Hildebrand	R. M. Zabel

PUBLICATIONS — To be responsible for the procurement, review and approval of all material for the publications of the Society other than technical papers approved by the Papers Committee for presentation at National Conferences of the Society and their discussions, and committee reports, for which it will have publication responsibility only. Shall also be responsible for the editing, printing and business management of the publications of the Society.

E. C. Huerkamp, Chairman, Westinghouse Elec. Corp., 1216 W. 58th St., Cleveland 1, Ohio

J. M. Stedman, Vice-Chairman, Pennsylvania Power & Light Co., Allentown, Pa.

H. H. Magdsick	R. G. Slauer

R. W. Staud

Sub-Committee on Advertising Sales

R. W. Staud, Chairman, Benjamin Electric Mfg. Co., Des Plaines, Ill.

Sub-Committee on Editorial Content

H. H. Magdsick, Chairman, General Elec. Co. Nela Park, Cleveland 12, Ohio

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O. P. Cleaver	H. M. Sharp
G. F. Dean	T. H. Shepherd
R. W. McKinley	T. D. Wakefield

Sub-Committee on Publication Sales and Distribution

R. W. McKinley, Chairman, 652 Morrison Drive, Mt. Lebanon, Pa.

Sub-Committee on Home Lighting Data Sheets

Mary B. Tsapks, Chairman, Detroit Edison Co., 2000 Second Ave, Detroit 26, Mich.

Jacob H. Blitzer	Stella Fetzer
Edith Buchholtz	Anthony Fodell
F. P. D'Esopo	Ruth Morris
Mary Dodds	Aileen Page
Lillian Eddy	Jan Reynolds

Sub-Committee on Technical Data Sheets

H. F. Scott, Chairman, McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N. Y.

George T. Anderson, Vice-Chairman, Philadelphia Electric Co., 1015 Chestnut St., Philadelphia 7, Pa.

Berlon C. Cooper	C. L. Crouch

Sub-Committee of Technical Data Sheet Reporters

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Ben Civin	G. F. Mudgett
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Haydn Hargest	Wayne L. Shaw
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E. W. Lampert	W. D. Williams
E. H. Lauth	R. R. Willoughby

Francis D. Wyatt

GENERAL COMMITTEES

ADVISORY BOARD ON COMMITTEE PERSONNEL — To examine the organization, accomplishments, and assignments of committees and prepare not later than June 1st of each year a proposed list of committees and personnel.

Walter Sturrock, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

C. L. Crouch	R. W. Staud
C. H. Goddard	L. E. Tayler
A. D. Hinckley	J. F. Whitehead, Jr.

BOARD OF NOMINATION — To prepare a nomination ticket containing the names of those who are deemed best suited to serve as officers and directors in positions to be filled at the ensuing election.

G. K. Hardacre, Chairman, Public Serv. Co. of No. Ill., 72 W. Adams St., Chicago 3, Ill.

R. W. Staud	L. E. Tayler

CONSTITUTION AND BY-LAWS — To prepare for Council amendments to the Constitution and By-Laws, as required, and to develop rules of procedure for the operation of the Society.

R. W. Corwin, Chairman, Benjamin Elec. Mfg. Co., 230 W. 17th St., New York 11, N. Y.

A. A. Brainerd	L. H. Graves
D. P. Caverly	S. R. McCandless

COORDINATING COMMITTEE FOR DEFENSE — To contact various Government Agencies concerned with National Security suggesting cooperation and participation in specific projects as an aid to solution of their problems. Recommending the placement of lighting study projects in present committees or the appointment of study project committees to the Society President and to expedite such study projects and guide accepted reports into proper Governmental channels.

A. F. Wakefield, Co-Chairman, F. W. Wakefield Brass Co., Vermilion, Ohio

Major G. D. Mills, Co-Chairman, 283 Osborne Ave., Brittania Heights, Ottawa, Ont., Canada

O. P. Cleaver	H. R. Jones
C. L. Crouch	Paul Manchester
S. L. Drumm	G. F. Mudgett
G. A. Fry	W. Sturrock

M. N. Waterman

Task Sub-Committee #3

J. A. Barteit	J. Mason Guillory
Howard Coleman	Cecil W. Mann

HISTORICAL — To assemble and make available for current reference and to prepare in suitable and durable form for posterity, such historical facts, printed memorabilia, photographs, voice records, museum specimens and allied items as may be judged worthy of composing a continuing digest of the record of the Society's history.

S. G. Hibben, Chairman, Westinghouse Elec. Corp., Bloomfield, N. J.

H. B. Dates	George Ainsworth
V. Lansingh	G. G. Cousins
Mrs. W. F. Little, Librarian	L. H. Graves
	G. H. Stickney

L. E. Tayler

LIGHTING SERVICE — To stimulate the discussion and practical application of lighting recommendations, standards, test procedures and other technical and scientific data developed by the Society to regional and local committees and to conduct a Lighting Service Forum in connection with the National Technical Conference.

J. S. Walsh, Chairman, Pacific Gas & Electric Co., 245 Market St., San Francisco 6, Calif.

H. H. Green, Vice-Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

R. W. Butte	Philip Peeples
Maxwell Cole	W. A. Stannard
R. R. Enghouser	H. A. Stroud
M. A. Havenhill	C. R. Tracy
H. Leland Holtman	L. C. Twichell
H. G. Hrivnats	John Walsh
F. E. Mueller	

LOCAL ACTIVITIES — To coordinate regional and local activities with the national program of the Society, assist Section and Chapter officers with local operating problems, conduct Local Activities Conferences, prepare plan to give members a better understanding of the Society, review applications for the establishment of new Sections and Chapters and recommend the appointment of local representatives.

S. G. Hibben, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

E. E. Ackland	G. F. Dean
G. W. Beals	E. H. Lauth
J. B. Browder	J. S. Schuchert
F. A. Covington	T. H. Shepherd

W. A. Stannard

MEDAL AWARD — To consider qualifications of candidates for I.E.S. Medal; submit recommendations to Council and prepare citation for the award.

G. K. Hardacre, Chairman, Public Serv. Co. of No. Illinois, 72 W. Adams St., Chicago 3, Ill.

G. W. Beals	W. C. Brown

G. G. Cousino — R. W. Staud
L. H. Graves — L. E. Tayler
J. L. Stair — D. M. Warren

MEMBERSHIP COMMITTEE — To develop plans and supervise the operation of the individual membership campaign in the Society.

Garlan Morse, Chairman, Sylvania Elec. Prods. Inc., 111 Sutter St., San Francisco 4, Calif.

J. H. Hull, Vice-Chairman, Fostoria Industrial Service, 222 Davidson Bldg., Des Moines 9, Iowa

George Bogard, Vice-Chairman, General Electric Co., 570 Lexington Ave., New York, N. Y.

Section and Chapter Representatives

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Nick Ball — Harold G. Linder
J. W. Bigley — Howard Long
Frank E. Brown — T. R. Lyda
Robert D. Carlen — Romeo Martineau
R. A. Conant — D. J. McKenzie
Howard B. Connell — H. J. Mazur
E. J. Copland — S. W. McKnight
M. J. Cote — Jay Mears
W. R. Crockett — John E. Metzenthin
J. F. Dickerhoff — C. Leon Moyer
Robert J. Diefenthaler — L. A. Niemeyer
W. J. Dorrans — John T. Parks
Edward C. Dunn — Clay C. Rittenhouse
E. A. Fargis — C. T. Roberts
A. Flechsig — Alton P. Rose
Nels Fugelsang — Joseph J. Sanders
W. A. Gale — E. E. Schwalm
Howard W. Grosh — C. J. Selby
H. L. Guiney — C. C. Shotwell
Herschel B. Hall — C. E. Smith
James H. Hull — W. A. Sparks
A. H. Johnson — Ralph H. Spaulding
R. C. Lambert — Fred P. Walter
H. A. Lawrence — Eugene West

NATIONAL TECHNICAL CONFERENCE — To supervise the 1950 Technical Conference, select the time and place for the 1951 and 1952 Technical Conferences and act as a depository of invitations for future conferences; study and report to Council the possibility of holding periodically a nationally sponsored technical conference for the Pacific Coast Zone.

R. F. Hartenstein, Chairman, Ohio Edison Company, Akron 8, Ohio

R. W. Butts, Vice-Chairman, The Ohio Public Service Co., 405 Broad St., Elyria, Ohio

A. I. Benedict — A. L. Perdue
R. R. Brady — D. W. Prideaux
Harry Grattan, Jr. — T. H. Shepherd
A. D. Hinckley — A. E. Simpson
K. E. Hollingsworth — H. P. Steele
C. C. Keller — L. W. Towner
R. E. Lange — J. S. Walsh

Conference Executive Committee

D. W. Prideaux, Chairman, General Elec. Co., 601 W. 5th St., Los Angeles 13, Calif.

Edward Balogh — S. H. Simonsen
Leonard Hobbs — Leonard Towner
W. E. Potter — J. S. Walsh

Conference Executive Committee, 1951

George W. Clarke, Chairman

PROCEDURES AND POLICIES — Analyze for Council current procedures and policies and make recommendations.

R. W. Staud, Chairman, Benjamin Electric Mfg. Co., Des Plaines, Ill.

R. R. Brady — L. E. Tayler
Ward Harrison — A. F. Wakefield
D. M. Jones — J. F. Whitehead, Jr.

PROFESSIONAL REQUISITES — To study and report on requisites for defining and improving the Professional Status of Illuminating Engineers, especially in reference to Society membership.

R. L. Biesele, Jr., Chairman, Southern Methodist University, Dallas, Texas

J. B. Browder — H. L. Logan
B. C. Cooper — E. M. Strong
W. H. Kahler — L. E. Tayler
Aksel Knudstrup — D. E. Trefry
F. I. Wilson

PROJECT PLANNING — To study the operations, program and policies of the Society with the view of its immediate and long-range objectives and recommend to Council new projects and programs to be established.

J. F. Whitehead, Jr., Chairman, Daybrite Lighting Corp., 5411 Bulwer Ave., St. Louis 7, Mo.

S. G. Hibben — R. C. Kinney
B. J. Jensen — E. D. Macdonald
D. M. Jones — W. F. White

PUBLIC RELATIONS AND INFORMATION — To prepare and disseminate information about the activities, accomplishments, programs, objectives and policies of the Society and about the place of illuminating engineering in modern society; to formulate and submit public relations policies and plans for the Society.

J. S. Schuchert, Chairman, Duquesne Light Co., 435 Sixth Ave., Pittsburgh 19, Pa.

R. R. Brady — R. A. Palmer
H. H. Green — John Ronayne
J. M. Hickerson — W. T. Stuart
P. F. Kauffman — L. W. Towner
James Krieger — G. A. Watters
G. F. Mudgett — S. B. Williams

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W. E. Folsom — E. W. Lampert
Gordon C. Fowler — L. W. O'Brien
R. C. Graham — Taylor Quipp
J. M. Hollingsworth — John H. Wanska

RESEARCH FUND COMMITTEE

L. E. Tayler, Chairman, Detroit Edison Co., 2000 2nd Ave., Detroit, Mich.

A. H. Manwaring — R. A. Staud
Robert A. Miller — S. B. Williams

RESIDENCE LIGHTING FORUMS — To reactivate and expand residence lighting forums, suggest programs for meetings, revise Guide for Residence Lighting Forums and conduct a National Residence Lighting Forum Conference in connection with the National Technical Conference.

Priscilla Presbrey, Chairman, Westinghouse Elec. Corp., Bloomfield, N. J.

Denyse Beraha — Ruth Morris
Mary E. Dodds — Florence O'Donnell
G. I. Dwinell — Jan Reynolds
Lillian E. Eddy — Margaret Salter
Myrtle Fahsbender — Mary Taepke
Caroline E. Horn — Mary E. Webber

SECTION AND CHAPTER PROGRAMS, COORDINATING COMMITTEE ON — To make a study of the subjects and topics of probable interest to our members, review previous section and chapter programs, and prepare a report of program suggestions for section and chapter meetings, technical forums and study clubs.

Carl A. Basedow, Chairman, 742 Ottawa, Park Ridge, Ill.

C. L. Amick — R. R. Lusk
J. R. Chambers — C. D. Miller
J. L. Kilpatrick — C. B. Pederson
G. E. Korten — C. C. Shotwell
R. E. Worstell

SUSTAINING MEMBERSHIP — To obtain additional Sustaining Members.

G. J. Taylor, Chairman, Day-Brite Lighting, Inc., 92 Liberty St., New York 6, N. Y.

Cecil L. Cannon — R. E. Lange
W. E. Folsom — E. H. Salter
D. M. Jones — Hugh X. Sheeter
P. F. Kauffman — C. C. Shotwell
C. E. Weitz

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G. W. Beals — E. H. Lauth
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F. A. Covington — T. H. Shepherd
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Robert C. Blatt — Arthur H. Molitor
H. J. Brandenburger — W. J. Montabone
Frank L. Carver — J. C. Nickersen
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Herschel B. Hall — Lester T. Wilcox
Frank R. Hallman — Walter N. Wildeman
Cyril D. Ham — Howard L. Wright
R. C. Zinsmeister

Tellers

Priscilla Presbrey, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

Emil Lampert — John Slevin
John Maguire — George Spiegel

Alternates

Max Gysi — Howard Rowland

TASK COMMITTEES

TASK COMMITTEE — JOINT I.E.S.-A.P.H.A. COMMITTEE — To discuss with A.P.H.A. objectives of mutual interest in illumination, to review the relationship of light and vision, to study a rational basis for the quality and quantity of illumination and develop a list of researches desirable for further knowledge and cooperative effort.

E. M. Strong, Chairman, Cornell University, Ithaca, N. Y.

L. E. Barbrow — C. L. Crouch
Glenn A. Fry

A.P.H.A. Representatives

Francis Elder, Secretary — Ralph J. Johnson
Leonard Greenburg — Donald Y. Solandt

TASK COMMITTEE — INCREASE IN MEMBERSHIP DUES

E. M. Strong, Chairman, Cornell University, Ithaca, N. Y.

R. W. Corwin — F. R. Knowles
C. H. Goddard — A. H. Manwaring
A. D. Hinckley — J. S. Schuchert
C. C. Keller — Walter Sturrock

TASK COMMITTEE ON CONFERENCE WITH THE NATIONAL COUNCIL FOR SCHOOLHOUSE CONSTRUCTION — To explore the field of mutual interest; to serve as a clearing house of expression regarding reports of both organizations; to study recommendations of quantity and quality of illumination and to develop a suggested program of study and research on specific illuminating problems applying to schools.

R. C. Putnam, Chairman, 2223 S. Overlook Rd., University Center Station, Cleveland 6, Ohio

L. H. Brown — W. V. C. Foulks
C. L. Crouch — L. B. Paist

TASK COMMITTEE ON FISCAL YEAR

Berlon C. Cooper, Chairman, McGraw-Hill Publishing Co., 330 W. 42nd St., New York 18, N. Y.

L. H. Graves — E. M. Strong
A. H. Manwaring — M. N. Waterman
S. B. Williams

TECHNICAL COMMITTEES

AVIATION LIGHTING — To study the application of light and lighting to the spaces and functions involved in the operation of aircraft.

Lewis B. Moore, Chairman, The Grimes Manufacturing Co., Urbana, Ohio

R. C. Blatt, Vice-Chairman, Electrical World, McGraw-Hill Publishing Co., 330 West 42nd St., New York 18, N. Y.

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Martin Warskow

Sub-Committee on Accident Investigation

R. C. Blatt, Chairman, Electrical World, 330 W. 42nd St., New York 18, N. Y.

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R. J. Stefany

Sub-Committee on Aircraft Lighting

R. A. Rugge, Chairman, 155 Lenwood Ave., E. Grand Rapids 6, Mich.

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H. A. Cramer	E. B. Hallman
H. Droge	G. M. Kevern
W. C. Fisher	D. C. Miller

H. P. Tanke

Sub-Committee on Airport Lighting

L. C. Vipond, Chairman, Civil Aeronautics Administration, Dept. of Commerce, Airport Lighting Div., Washington 25, D. C.

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W. A. Pennow

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G. K. Clement	R. E. Madigan
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O. Farris	L. C. Simpson
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V. J. Roper, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

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J. D. Hall	J. M. Roper

R. A. Rugge

Sub-Committee on Compendium for Signal Lighting

F. C. Breckenridge, Chairman, National Bureau of Standards, Wash. 25, D. C.

J. A. Bartelt	W. E. K. Middleton
H. R. Blackwell	H. J. C. Pearson
C. L. Crouch	L. C. Simpson
W. T. Harding	Richard Tousey

M. A. Warskow

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F. C. Breckenridge, Chairman, National Bureau of Standards, Wash. 25, D. C.

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R. C. Blatt	R. E. Dahlin

R. J. Stefany

Sub-Committee on Program and Publicity

R. C. Blatt, Chairman, Electrical World, 330 W. 42nd St., New York 18, N. Y.

Sub-Committee on Taxiway Lighting

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F. C. Ashe	J. P. Hoxie
F. B. Brady	G. M. Kevern
B. A. Hemelt	A. L. Lewis

H. J. C. Pearson

COLOR AND ILLUMINATION — To study, evaluate and report on the effect of color in relation to the art and science of illumination.

Ralph Evans, Chairman, Eastman Kodak Co., 65 Kodak Park, Rochester 4, N. Y.

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A. A. Brainerd	W. H. Kahler
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Carl E. Foss	Dorothy Nickersen
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J. P. Guilford	A. H. Taylor

Kenneth Welch

DAYLIGHTING — To study the problems involved in daylighting, develop recommended practices and report thereon.

R. L. Biesele, Jr., Chairman, Southern Methodist University, Dallas, Texas

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A. H. Baker	J. A. Meacham
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E. W. Conover	L. B. Perkins
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B. F. Greene	W. C. Randall
J. S. Herbert	D. E. Spencer
George N. Hingston	George W. Thomas
R. W. Hudson	H. B. Vincent
F. L. Knowles	A. Vogel
W. F. Little	George B. Watkins

Kenneth C. Welch

FARM BUILDINGS AND WORK AREA LIGHTING — To study the application of light and lighting of farm buildings, surrounding work areas and other rural locations and to report thereon.

O. D. Hunt, Chairman, Kansas State College, Manhattan, Kan.

T. M. Barr	P. H. Hildebrand
Edith Buckholtz	Arthur Kramer
J. P. Ditchman	Joseph Schaenzer

A. J. Von Burg

HANDBOOK REVISION — To revise and arrange the technical content of the Handbook; to lay out, plan and arrange for development of individual sections primarily through appropriate technical committees; to establish and maintain liaison with the Publications Committee with reference to production matters and the preparation of a budget which will be submitted by the Publications Committee to Council for approval; to be responsible to Council for the technical accuracy and treatment of material to be turned over to the Publications Committee for publication.

R. J. Jensen, Chairman, Pub. Serv. Elec. & Gas Co., 80 Park Place, Newark 1, N. J.

Willard Allphin	Duncan M. Jones
C. L. Cottrell	J. L. Tugman
G. Ross Henninger	M. N. Waterman

ILLUMINATION PERFORMANCE RECOMMENDATIONS — To prepare illumination performance recommendations for luminaires conforming to I.C.I. classifications, excluding residential.

J. F. Parsons, Chairman, Buffalo Niagara Electric Corp., Buffalo 3, N. Y.

R. S. Benson, Jr.	W. F. Little
S. K. Guth	R. S. Rogge
W. H. Kahler	R. P. Teele

G. P. Wakefield

INDUSTRIAL LIGHTING—To revise the 1942 "American Recommended Practice of Industrial Lighting" with full consideration to the brightness approach, and with Council approval, to submit for American Standards Association approval.

W. C. Brown, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

E. A. Linsday, Secretary

G. W. Beals	Harry Keene
L. H. Brown	W. F. Lowell, Jr.
W. E. Folsom	C. C. Shetwell
W. H. Kahler	H. P. Steele

M. N. Waterman

LIGHT CONTROL AND EQUIPMENT DESIGN — Collect and correlate the knowledge and data on means and methods of controlling, directing, reflecting, transmitting, and diffusing light and on the principles and practices of equipment design.

F. C. Winkler, Chairman, Westinghouse Elec. Corp., 1216 W. 58th St., Cleveland 1, Ohio

R. D. Bradley, Vice-Chairman, Day-Brite Lighting, Inc., St. Louis, Mo.

George Arras	Kurt Franck
O. R. Baumgartner	C. N. Laupp
B. S. Benson, Jr.	Franklin M. Neal
Eric H. Church	David L. Williams

Joint Sub-Committee on Plastics for Lighting

A. B. Oday, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

M. H. Bigelow	W. F. Little
E. H. Church	W. P. Lowell, Jr.

F. C. Winkler

LIGHT SOURCES—To correlate and report available information as to the physics of light and light production and the characteristics of current light sources.

E. F. Lowry, Chairman, Sylvania Elec. Prods. Inc., 60 Boston St., Salem, Mass.

E. H. Raddin, Vice-Chairman, 18 Smith Rd., Saugus, Mass.

James Cox	B. F. Greene
H. P. Davidson	J. O. Kraehenbuehl
Arthur C. Downes	A. B. Oday
G. S. Evans	R. C. Putnam

E. H. Salter

LIGHTING AND AIR CONDITIONING — To study the relationship between lighting and various factors that enter into air conditioning and report thereon.

E. H. Salter, Chairman, Electrical Testing Laboratories, Inc., 2 East End Ave. & 79th St., New York, N. Y.

Samuel Adams Bogen	R. H. Lusk

H. M. Sharp

Representatives of American Society of Heating and Ventilating Engineers

M. C. Beman	J. N. Livermore

G. B. Priester

LIGHTING AND ARCHITECTURE — To study the application of light and lighting in the field of architecture. To plan an interchange of knowledge and data between the architectural profession and the I.E.S. To plan and develop lighting design competitions in architectural schools. To report to the Society on assignments falling within this scope.

H. E. D'Andrade, Chairman, General Electric Co., 570 Lexington Ave., New York 22, N. Y.

W. M. Potter, Vice-Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

Willard Allphin	David H. Mason
C. L. Amick	W. H. McAdams
A. C. Bergh	S. R. McCandless
Harry C. Blackburn	Oscar W. Meissner
F. D. Bolton	A. H. Mendel
Ross M. Brown	J. H. Murrah
Cecil I. Cady	Victor J. Ouellette
Ralph R. Cheney	Earl E. Parks
C. O. Christensen	Fred M. Pyle
Raymond P. Connors	Arthur S. Raffel
J. H. Dean	E. Rambusch
Earle C. Edwards	Frank G. Reed
Howard Ernst	W. R. Robison
E. M. Fahey	C. A. Rost
Dan M. Finch	Harold L. Salaun
H. L. Frazier	J. Homer Shaw
W. B. Fulton	Ray A. Siedle
E. H. Grieb	E. M. Steen
Robert Hamilton	Ralph H. Thatcher
Arthur P. Hammerstrom	Jess D. Thomas
A. R. Hampsey, Jr.	Paul T. Tysinger
H. G. Hrivnats	O. A. Watters
Henry R. Huber	D. Roland Webb
Milton Johns	J. Daniel Webster
Leon T. Johnson	Harold R. Weibel
Lucian T. Kight	Kenneth C. Welch
H. W. Larson	G. M. Whittaker

Edmund F. Wilson

LIGHTING DESIGN PRACTICE — To study published data on coefficients of utilization, room indexes, maintenance coefficients and other elements entering into calculations for lighting design, develop standard methods

for use in Society publications and report thereon.

C. L. Amick, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

Neal Jacobus, Vice-Chairman, 407 Jackson Bldg., Buffalo 12, N. Y.

B. S. Benson, Jr.	John Neidhardt
J. H. Dean	J. F. Parsons
J. R. Jones	R. S. Rogge
J. O. Kraehenbuehl	E. H. Salter

LIGHTING EDUCATION — To prepare educational and training programs on the fundamentals of illumination, lighting design problems and advance theories of light and lighting application. To prepare required text material and to further their adoption locally.

C. D. Miller, Chairman, Duquesne Light Co., 435 Sixth Ave., Pittsburgh 19, Pa.

C. E. Weitz, Vice-Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

Warren B. Boast	Ralph Lusk
C. W. Clarkson, Jr.	David H. Mason
O. D. Hunt	H. L. McKinley
W. B. Kennedy	J. F. Parsons
Carter Lewis	C. E. Robison, Jr.
Robert Ligare	H. A. Stroud

Carl W. Zersen

Joint Sub-Committee I.E.S. - U. S. Public Health Service

J. F. Parsons, Chairman, Buffalo Niagara Electric Corp., Buffalo 3, N. Y.

Louis Cahill	R. E. Ligare
George D. Clayton	James Ligon
F. H. Heintz	R. R. Lusk
Don Ingwersen	Tula Salpus

A. A. Sobolik

Sub-Committee on Pictorial Presentation of Illumination Measurement and Terms

B. S. Benson, Jr., Chairman, Benjamin Electric Mfg. Co., Des Plaines, Ill.

F. H. Heintz	R. R. Lusk
D. N. Ingwersen	F. J. Marriott
R. E. Ligare	A. A. Sobolik

LIGHTING OF CENTRAL STATION PROPERTIES — To study and report on the lighting of electric power generating plants and their power distribution facilities.

A. A. Brainerd, Chairman, Philadelphia Elec. Co., 900 Sansom St., Philadelphia 5, Pa.

R. S. Bucher	P. E. King
H. A. Cook	Carter Lewis
R. W. Corwin	Walter B. Morton
H. E. D'Andrade	W. S. Mowry
V. L. Dzwonczyk	L. G. Parks
C. E. Egeler	D. W. Taylor
R. M. Graves	D. H. Tuck

LIGHTING MAINTENANCE

D. C. Freeman, Chairman, 4330 Davenport St., N. W., Washington 16, D. C.

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R. L. Biesele, Jr.	R. C. Putnam
Eric Church	R. S. Rogge
E. W. Fowler	R. P. Teele

G. P. Wakefield

LIGHTING STUDY PROJECTS IN EDUCATIONAL INSTITUTIONS — To study the application of light and lighting to the spaces and processes involved in educational institutions and to report thereon.

R. C. Putnam, Chairman, 2223 S. Overlook Rd., University Center Station, Cleveland 6, Ohio

Carl J. Allen, Secretary

Willard Allphin	W. G. Darley
R. L. Biesele, Jr.	W. V. C. Foulks
Warren B. Boast	S. K. Guth
L. H. Brown	L. V. James
J. M. Charlton	W. H. Kahler

C. N. Laupp

Sub-Committee on Brightness Conditions in Educational Environments

C. N. Laupp, Chairman, Wisconsin Elec. Power Co., 231 W. Michigan St., Milwaukee 1, Wis.

Willard Allphin	W. H. Kahler
J. M. Charlton	O. Phelps Meaker
W. E. Folsom	L. B. Paist
L. V. James	J. S. Walsh

Sub-Committee on Chalkboards

J. M. Charlton, Chairman, Toronto Board of Education, 155 College St., Toronto 2B, Ont., Canada

H. F. Davidson	H. Cecil Jones
Wayne Jervis	E. W. Moodie

Sub-Committee on Student Vision and Scholarship

S. K. Guth, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

R. M. Hall	W. A. Monroe
B. L. Hamon	C. P. Tolman

R. B. Tracht

Sub-Committee on Visual Problems

Warren B. Boast, Chairman, Iowa State College, Ames, Iowa

J. M. Charlton	Ray L. Hamon
Arthur A. Eastman	Paul Seagers
Grace C. Hamman	N. E. Viles

Marjorie J. C. Young

LIGHTING STUDY PROJECTS IN INDUSTRY — To initiate, follow up and coordinate lighting study projects in the industrial field, review the reports of the various subcommittees in this field and make recommendations to Council.

E. W. Fowler, Chairman, Buffalo Niagara Electric Corp., Buffalo, N. Y.

J. R. Chambers	W. P. Lowell, Jr.
C. E. Egeler	C. G. Rae
C. D. Hollister	M. N. Waterman

Lighting in Bakeries

F. J. Vodicka, Chairman, Commonwealth Edison Co., 2233 S. Throop St., Chicago 8, Ill.

F. C. Bing	J. C. Weeks
W. B. Bradley	G. C. Fowler

Lighting in the Canning Industry

Carl O. Martin, Chairman, Benjamin Electric Mfg. Co., 449 Bryant St., San Francisco 7, Calif.

L. H. Brown	R. S. Prussia
S. H. Hazleton, Jr.	Robert Thallon
K. M. Noble	David C. White

H. K. Wilder

Lighting in the Fluid Milk Industry

O. A. Hill, Jr., Chairman, Public Service Co. of N. Illinois, 1701 S. First Ave., Maywood, Ill.

Lighting in Foundries

Frank E. Mueller, Chairman, Cleveland Electric Illuminating Co., 75 Public Sq., Cleveland, Ohio

C. W. Briggs	C. E. Egeler
A. L. Collier	J. H. Lansing

J. W. Steiner

Lighting in Laundries

O. A. Hill, Jr., Chairman, Public Service Co. of N. Illinois, 1701 S. First Ave., Maywood, Ill.

G. F. Allen	R. R. Hill
J. R. Chambers	Carl F. Jensen
A. L. Christensen	R. R. Lusk

W. S. E. Miller

Lighting in Leather Manufacturing

Edward J. White, Chairman, Edward J. White Co., 351 Broadway, Newark 4, N. J.

I. J. Chesley	L. A. Robinson
B. J. Jensen	George H. Scherer
W. G. Morrison	R. W. Stanley

Lighting for the Printing Industry

George W. Clarke, Chairman, Sylvania Electric Products, Inc., 15th and New York Ave., N. W., Washington 5, D. C.

W. A. Anderson	C. C. Hayes
Peter Backer, Jr.	V. P. Scheidt
R. R. Bransdorf	B. J. Taymans

H. M. White

Lighting in Sheet Metal, Stamping, Folding and Shearing

Floyd W. Sell, Chairman, Detroit Edison Co., 2000 Second Ave., Detroit 26, Mich.

Howard A. Beits	J. M. Marlin
E. L. Frase	Ted Rougly

Lighting in Steel Mills

A. Paulus, Chairman, Westinghouse Electric Corp., 419 Wood St., Pittsburgh 22, Pa.

J. J. Booth	H. Hargest
C. M. Cryder	Lucian T. Kight
C. J. Enlind	H. J. Masur

Carlton Ostrom

Supplementary Lighting

W. H. Kahler, Chairman, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland 2, Ohio

G. F. Dean	E. A. Lindsay
L. E. Goble	R. E. Mauk

Lighting in the Textile Industry

W. L. Kelley, Jr., Chairman, New England Machine & Electric Co., 77 Bayley St., Pawtucket, R. I.

Walter P. Rayner	F. J. Verlander, Jr.
J. M. Shute	J. E. Watkins

LIGHTING STUDY PROJECTS IN PUBLIC BUILDINGS AND PRIVATE INSTITUTIONS—To initiate, follow up and coordinate lighting study projects in the field of public buildings and private institutions, review the reports of the various study subcommittees in this field and make recommendations to Council.

R. S. Rogge, Chairman, 9117 Prevost Ave., Detroit 28, Mich.

C. I. Brady	J. M. Ketch
J. R. Jones	J. L. Kilpatrick

C. C. Shotwell

Lighting in Auditoriums and Churches

David H. Mason, Chairman, Mason & Basedow, 1415 W. Adams St., Chicago 7, Ill.

Louis Gold	Charles W. McCormick
W. Kennedy	Edward Rambusch

A. C. Sangster

Lighting in Hospitals

Howard Haynes, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

H. W. Alexander	Harry Grattan, Jr.
D. L. Angus	E. H. Greppin
J. C. Connor	J. J. Neidhart
B. C. Cooper	Floyd W. Sell
W. J. Engle	Albert Zack

Lighting in Hotels

Myrtle Fahsbender, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

J. Fassett	Joseph Manucia
Hugh S. James	Gladys Miller
Francis Keally	C. I. Sayles

Lighting in Theatres

C. M. Cutler, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

Eugene Braun	James McCulloch
Thomas W. Butler	Edward Rambusch
J. R. Cravath	Ben Schlanger
Theodore Fuchs	Hunton D. Sellman
J. S. Hamel	George Smedberg
S. G. Hibben	Daniel Staehle
Edward B. Kirk	R. Gillespie Williams
Herbert Kliegl	Frederick M. Wolff

NOMENCLATURE — To define the terms and standards of illumination; and endeavor to obtain uniformity in nomenclature.

Harris Reinhardt, Chairman, Sylvania Elec. Prods. Inc., 1790 Broadway, New York 19, N. Y.

J. O. Kraehenbuehl, Vice-Chairman, University of Illinois, Urbana, Ill.

E. Q. Adams	W. F. Little
H. P. Gage	M. Luckiesh
K. S. Gibson	A. E. Parker
S. K. Guth	Priscilla Prosbrey
L. A. Jones	H. P. Steele

OFFICE LIGHTING — To study the lighting requirements of office lighting tasks, develop suitable lighting recommendations and report thereon.

G. P. Wakefield, Chairman, F. W. Wakefield Brass Co., Vermilion, Ohio

G. F. Dean, Vice-Chairman, Toronto Hydro-Electric System, 14 Carlton St., Toronto, Ont., Canada

A. S. Almryde	R. W. McKinley
T. F. Coghlan	John Neidhart
W. E. Folsom	R. L. Oetting
G. C. Fowler	George J. Taylor
Harry Keene	William Trott
William C. Macy	Roger T. Waite

R. L. Zabour

Project Committee on Characteristics of Office Materials, Equipment and Related Environment Factors

A. S. Almryde, Chairman, Public Service of N. Illinois, Skokie Highway, Northbrook, Ill.

B. A. Thomas, Vice-Chairman, General Electric Co., 901 Genesee Bldg., Buffalo 2, N. Y.

W. C. Granville	William Trott
H. J. Mahaffey	J. G. L. Walden

Project Committee on Depreciation and Maintenance of Office Lighting Systems

G. P. Wakefield, Chairman, F. W. Wakefield Brass Co., Vermilion, Ohio

J. H. Murrah	G. J. Taylor

Project Committee on Performance of Lighting Systems

G. C. Fowler, Chairman, Public Service Co. of N. Illinois, Skokee Highway, Dundee Rd., Glencoe, Ill.

W. C. Macy	J. H. Murrah
H. J. Mahaffey	James P. Warner

Project Committee on Recommendations for Specific Areas

G. F. Dean, Chairman, Toronto Hydro-Electric System, 14 Carlton St., Toronto, Ont., Canada

A. S. Almryde	John Neidhart
Walter J. Lind	Harris Reinhardt
W. C. Macy	R. J. Rudrow

Project Committee on Task Evaluation

R. L. Oetting, Chairman, General Electric Co., Nela Park, Cleveland, Ohio

George J. Taylor

PROGRESS — To keep in touch with developments in the art of lighting throughout the world and prepare a yearly review of achievements in the art of illuminating engineering for inclusion in ILLUMINATING ENGINEERING.

Alston Rodgers, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

T. Sargent, Vice-Chairman, Sylvania Electric Products, Inc., Salem, Mass.

A. C. Barr	Walter J. Jones
E. W. Beggs	Arthur P. Larson
M. H. Bigelow	E. A. Linsday
O. P. Cleaver	J. A. Meacham
Paul D. Cornelisen	J. W. Steiner
J. M. Howard	A. S. Tylor

PROTECTIVE LIGHTING — To prepare standards for protective lighting of plants, yards, boundary fences, adjoining highways, railroad sidings, and waterway approaches for the purpose of reducing fire and theft risks, and making policing more effective.

J. W. Lee, Chairman, Philadelphia Electrical & Mfg. Co., 1236 N. 31st St., Philadelphia 21, Pa.

J. C. Forbes	Van Edward Marker
M. C. Harsh	Gene Rae
H. E. Mahan	Dana W. Rowten

PUBLIC CONVEYANCES — INTERIOR LIGHTING — To study the application of light to all public areas in conveyances used for passenger transportation, including particularly trains, buses, ships, street railways and subways and report thereon.

E. W. Beggs, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

A. L. Arenberg	William Fall
Charles I. Brady	J. L. Heine
J. de la Rosa	H. H. Heimbright
E. E. Dorting	W. C. Wheeler

Randolph Whitefield

RESEARCH COMMITTEE — To survey and report on all significant research dealing directly or indirectly with the application of light and lighting and its effect upon the performance and comfort of human beings not conducted by the I.E.S. Research Trust Fund, to survey the whole field of lighting to determine and report on subjects which require scientific verification through research, and to coordinate various types of research affecting lighting which are now being conducted by various agencies.

H. L. Logan, Chairman, Holophane Co. Inc., 342 Madison Ave., New York 17, N. Y.

O. H. Biggs	G. F. Mudgett
O. P. Cleaver	S. R. Naysmith
H. F. Davidson	E. M. Strong
S. K. Guth	Miles A. Tinker
D. B. Harmon	H. O. Warner

W. F. White

RESIDENCE LIGHTING — To study the application of light and lighting to the home, including the study of the aesthetic phase of residential lighting, to prepare some practical reference for good lighting practices in period interiors and to report thereon.

E. W. Commery, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

Mary E. Webber, Vice-Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio

Mary Dodds	Thomas Kelly
Myrtle Fahsbender	W. F. Little
Katharine T. Goodall	Gladys Miller
Mary W. Held	Priscilla Presbrey
J. J. Jasin	Jan Reynolds

Norman Vacha

Sub-Committee on Contemporary Lighting Practices in Traditional and Modern Interiors

Myrtle Fahsbender, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

Gladys Miller	Jan Reynolds

Mary Webber

Sub-Committee on Cooperation with Residence Fixture Manufacturers

Norman Vacha, Chairman, John C. Virden Co., 6009 Longfellow Ave., Cleveland 3, Ohio

W. A. Feuillan, Jr.

Sub-Committee on Lighting and Viewing Habits Associated with Television Receivers in the Home Survey

Mary E. Dodds, Chairman, Toledo Edison Co., Edison Bldg., Toledo 4, Ohio

Study Projects for Undergraduate Students

Thomas S. Kelly, Chairman, Thomas S. Kelly Lighting, 115 E. 60th St., New York 22, N. Y.

SPORTS AND RECREATIONAL AREA LIGHTING — Develop current recommended practices for lighting sports and recreational areas; study techniques of application including effects on player performance and spectator visibility, and report thereon.

R. J. Swackhamer, Chairman, General Electric Co., 920 Western Ave., Lynn, Mass.

A. H. Clarke, Vice-Chairman, Crouse-Hinds Co., Syracuse, N. Y.

J. W. Bateman	Frank R. Jeffrey
B. S. Benson, Jr.	Merle E. Keck
Earl D. Benson	J. W. Lee
H. E. Carney	Kirk M. Reid
J. G. Felton	M. W. Ross
A. B. Hallaway	Dana W. Rowten
H. F. Ilgner	D. E. Trefry

STANDARDS OF QUALITY AND QUANTITY FOR INTERIOR ILLUMINATION — To prepare standards for illumination levels, brightness limits, brightness ratios for interiors including specific visual tasks, as well as the general surroundings.

Louis E. Barbrow, Chairman, National Bureau of Standards, Washington 25, D. C.

Willard Allphin, Vice-Chairman, Sylvania Electric Products, Inc., Salem, Mass.

M. E. Bitterman	Ward Harrison
H. R. Blackwell	H. L. Logan
G. A. Fry	Donald Solandt
S. K. Guth	D. E. Spencer
LeGrand Hardy	E. M. Strong

STORE LIGHTING — To study the application of light and lighting to the spaces and processes involved in the selling of goods and to report thereon.

D. P. Caverly, Chairman, Sylvania Elec. Prods. Inc., 1790 Broadway, New York 19, N. Y.

R. C. Allison, Vice-Chairman, T. Eaton Co., 190 Yonge St., Toronto, Ont., Canada

Edward Ashley	J. J. Neidhardt
Howard Ketcham	W. M. Potter
J. R. Jones	K. C. Welch

STREET AND HIGHWAY LIGHTING — To establish the scientific principles underlying Street and Highway Lighting; to collect data on the results of the application of such principles to actual practice; to prepare such reports thereon as will assist technicians and benefit the public.

R. M. Zabel, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

L. J. Schrenk, Vice-Chairman, Public Lighting Commission, City of Detroit, 174 Atwater St., Detroit 26, Mich.

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R. M. Hoot	Stuart R. Williams
H. F. Ilgner	H. L. Wojcik
G. W. Izant	F. D. Wyatt

John Young

Accident Surveys

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Co-ordination

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J. W. A. Bollong	E. B. Karns

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R. M. Hoot	R. E. Simpson
H. F. Ilgner	Stuart R. Williams
G. E. Korten	F. D. Wyatt

Forestation

O. P. Ortlieb, Chairman, 123 Municipal Bldg., Trenton 8, N. J.

R. P. Brotzman	Kirk M. Reid
R. M. Hoot	L. J. Schrenk

G. A. Trosper

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Pavement Surfaces and Safety Lighting

F. D. Wyatt, Chairman, Chicago Park District, 425 E. 14th Blvd., Chicago 5, Ill.

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R. R. Gray	W. A. Shaw
C. A. B. Halvorson	G. A. Trosper
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R. S. Bucher	G. K. Hardacre
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Public Lighting and Traffic Safety
G. K. Glass, Chairman, Detroit Edison Co., 2000 2nd Ave., Detroit 26, Mich.
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Research
Kirk M. Reid, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio
D. M. Finch — D. W. Rowten
G. W. Izant — R. G. Slauer
F. D. Wyatt

Special Committee on I.E.S. Lighting Handbook
G. E. Korten, Chairman, Consumers Power Co., 212 W. Michigan Ave., Jackson, Mich.
G. K. Glass — R. G. Slauer
J. F. McGough — R. M. Swetland
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Special Committee on Interchange with Foreign Groups
W. H. Edman, Chairman, Line Material Co., 800 N. 8th St., Milwaukee 1, Wis.
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Special Committee on Photographic Studies
R. M. Hoot, Chairman, Philadelphia Electric Co., 1000 Chestnut St., Philadelphia 5, Pa.
E. T. Hawkins — G. E. Korten
J. L. Tupper

Special Committee on Revision of 1937 Report "Principles of Street Lighting"
Stuart R. Williams, Chairman, Holophane Co., Inc., Newark, Ohio
H. F. Ilgner — Kirk M. Reid
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Special Committee on Standard Practice
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J. H. Hays — E. B. Karns
O. W. Holden — John Young

Study Assignments in Accident Surveys

J. W. A. Bolong	A. T. Nadeau
G. C. Buchanan	R. S. Newhall
F. M. Carter	J. J. Oberhausen
P. N. Clerke	T. T. Peake
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C. V. Doherty	E. J. Perkins
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A. W. Fowle	K. M. Reid
G. C. Fowler	D. W. Rowten
W. F. Graff	W. W. Sanders
C. R. Hazard	F. J. Schmitt
L. F. Heckman	L. J. Schrenk
H. L. Holtman	R. J. Seitz
R. M. Hoot	R. M. Swetland
L. M. Johnson	G. A. Trosper
E. B. Karns	C. E. Waldron
K. E. Kraemer	John Young
A. H. Manwaring	Albert Zack

TECHNICAL COMMITTEE FORUM — To coordinate procedures of our technical committees and to sponsor a lighting application symposium at the National Technical Conference.
Walter Sturrock, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio
E. W. Beggs — W. C. Brown
B. S. Benson, Jr. — W. V. C. Foulks
E. W. Fowler

TELEVISION — To study and report on the lighting for (a) production of television programs and (b) for optical reception of television programs.
H. A. Kliegl, Chairman, Kliegl Bros. Universal Electric Stage Lighting Co., 321 W. 50th St., New York 19, N. Y.

Robert Bannon	R. C. Lanciano
F. C. Carlson	R. S. O'Brien
D. P. Caverly	Gertrude Rand
E. W. Commery	Lionel Rodgers
R. M. Gurin	Ernst Wolf
H. Kozanowski	R. L. Zahour

TESTING PROCEDURES FOR ILLUMINATION CHARACTERISTICS — To prepare standard test procedures for illumination characteristics of light sources, lighting equipment and illumination materials, and to report thereon.
Ray P. Teele, Chairman, National Bureau of Standards, Washington 25, D. C.
S. McK. Gray, Vice-Chairman, Sylvania Electric Products, Inc., Salem, Mass.

A. C. Barr	G. A. Horton
E. W. Beggs	Rudolph Hultgren
J. E. Bock	G. E. Korten
Eric H. Church	Arthur P. Larson
D. M. Finch	W. F. Little
Kurt Franck	D. L. Markle
B. F. Greene	James M. McCulloch

LOCAL REPRESENTATIVES

Canadian Region

Brantford, Ontario—S. Murchie, Brantford Township Hydro Electric System
Calgary, Alberta—H. J. McEwan, Canadian Westinghouse Co., Ltd.
Galt, Ontario—John E. Teckoe, Jr., Public Utilities Commission
London, Ontario—W. S. Hardman, Service Lamp Co., Ltd.
Napanee, Ontario — David F. Every, Hydro-Electric Power Comm. of Ontario
Peterborough, Ontario—Ross L. Dobbin, Peterborough Utilities Commission
Port Arthur, Ontario — H. E. Stafford, 305 Argyle St.
Regina, Saskatchewan — C. W. Buchanan, Northern Electric Co., Ltd.
St. Catherines, Ontario—William LeGallais, Niagara Vallance Brown Co.
St. John, N. B.—C. T. Roberts, Northern Electric Co.
Sherbrooke, Quebec — Andrew DuChene, Box 743
Sudbury, Ontario—E. T. Querney, Northern Electric Co., Ltd.
Trois Rivieres, Quebec—Dionis D. Hebert, 595 Niverville St.
Windsor, Ontario—W. A. Shaw, Windsor Utilities Commission

East Central Region

Allentown, Pa.—Francis E. Glick, Pennsylvania Power & Light Co.
Altoona, Pa.—Robert J. Nuphaker, Pennsylvania Electric Co.
Atlantic City, N. J.—D. D. Lees, Atlantic City Electric Co.
Bellaire, Ohio—C. L. Bullock, Ohio Power Co.
Bethlehem, Pa. — E. W. Halteman, Pennsylvania Power & Light Co.
Blacksburg, Va.—Claudius Lee, Virginia Polytechnic Institute
Camden, N. J.—James H. McQuestion, Public Service Electric & Gas Co.
Charlottesville, Va.—L. L. Holladay, 434 Brandon Avenue
Easton, Pa.—D. A. Wismer, Metropolitan Edison Co.
Erie, Pa. — Joseph L. Warfel, Pennsylvania Electric Co.
Hanover, Pa.—Edward H. Blettner, Metropolitan Edison Co.
Harrisburg, Pa.—E. W. Kelsey, Pennsylvania Power & Light Co.
Hazleton, Pa.—Howard J. Kreitzberger, Pennsylvania Power & Light Co.
Johnstown, Pa.—Howard E. Ross, R. D. #4, P. O. Box 324
Kingston, Luzerne Co., Pa. — John G. Henninger, P. O. Box 1348
Lancaster, Pa.—Ford M. Gochenauer, Pennsylvania Power & Light Co.
Lebanon, Pa.—Charles C. Russell, Jr., Metropolitan Edison Co.
Lexington, Va.—J. S. Jamison, Jr., Virginia Military Institute
Morgantown, W. Va.—William C. Wade, Monongahela West Penn Public Service Co.
Moundsville, W. Va.—G. F. Morgan, Wheeling Electric Co.
New Castle, Pa.—R. L. James, Pennsylvania Power Co.
Newport News, Va. — Clarence P. Andrew, Noland Co.
Pottsville, Pa.—Rolland W. Rodgers, Pennsylvania Power & Light Co.
Reading, Pa.—Frank E. Heins, Metropolitan Edison Co.
Richmond, Va.—George E. Schraudt, Jr., 812 St. Christopher Rd.
Scranton, Pa.—Frank B. Moore, General Electric Supply Corp.
Shenandoah, Pa.—Harry T. Weidman, Pennsylvania Power & Light Co.
State College, Pa.—David L. Markle, 334 So. Burrows St.
Stroudsburg, Pa.—J. E. Wagner, Line Material Co.
Sunbury, Pa.—William H. Heim, Pennsylvania Power & Light Co.
Towanda Pa.—C. T. Troy, Northern Pennsylvania Power Co.
Williamsport, Pa. — Gleason E. Solley, 1103 Isabella St.
Wilmington, Del.—Edward F. Lafond, Delaware Power & Light Co.
York, Pa.—Laurence O. Buckner, Metropolitan Edison Co.

Great Lakes Region

Akron, Ohio—Malcolm V. Tillett, Ohio Edison Co.
Alliance, Ohio—John R. Sweeny, Ohio Public Service Co.
Astabula, Ohio — John E. Lundi, Cleveland Electric Illuminating Co.
Binghamton, N. Y.—Earl C. Edwards, New York State Electric & Gas Corp.
Canton, Ohio—E. A. Berry, The Ohio Power Co.
Cincinnati, Ohio — Russel J. Dickason, 4021 Carrie Ave.
Corning, N. Y.—John P. Hoxie, Corning Glass Works
Dayton, Ohio—T. F. Keister, Duellman Electric Co.
Elyria, Ohio — G. C. Rubenson, Ohio Public Service Co.
Fostoria, Ohio—Ira J. Barber, 446 Fremont Dr.
Frankfort, Ky. — Meredith McKinney, P. O. Box 165
Fremont, Ohio—H. A. Gavitt, 2131 S. Buckland Ave.
Grand Rapids, Mich.—Harold P. Earley, Consumers Power Co.
Huntington, W. Va.—William M. Langstaff, Appalachian Electric Power Co.
Jackson, Mich. — Leslie D. Lyon, Consumers Power Co.
Lexington, Ky.—Robert W. Wilson, Kentucky Utilities Co.
Lima, Ohio—C. F. Daugherty, The Ohio Power Co.
Louisville, Ky.—Ray F. Tillman, The Brecher Co.
Mansfield, Ohio — Orlo L. Smith, Ohio Public Service Co.
Marion, Ohio—LeRoy W. Clauer, Ohio Public Service Co.
Masilion, Ohio—Jesse R. Parsons, Ohio Public Service Co.
Newark, Ohio — Kurt Franck, Holophane Co., Inc.
Portsmouth, Ohio — J. Richardson Thomas, 1911 Franklin Ave.
Saginaw, Mich.—Earl R. Domoney, Consumers Power Co.
Sandusky, Ohio — C. H. Smith, Ohio Public Service Co.
Toledo, Ohio — E. F. Schmidt, Toledo Edison Co.
Utica, N. Y. — Raymond F. McGuinnes, Central New York Power Corp.
Warren, Ohio—Walter C. Schultz, Ohio Public Service Co.
Westerville, Ohio — Fred B. MacRae, 6908 S. State Rd.
Youngstown, Ohio, — John G. Stewart, Ohio Edison Co.

Midwestern Region

Ames, Iowa—Warren B. Boast, Iowa State College
Cedar Rapids, Iowa—J. C. Young, Jr., 2400 E Ave., N. E.
Davenport, Iowa — Foun C. Horton, General Electric Co.
Des Moines, Iowa—George G. Fletcher, 3103 University Ave.
Dubuque, Iowa — Frank E. Boecher, 1410 Parkway

Duluth, Minn. — M. G. Braden, Minnesota Power & Light Co.
Eau Claire, Wis.—S. R. Gram, Northern States Power Co.
Evansville, Ind.—Ned S. Muse, Graybar Electric Co.
Evansville, Ind.—R. M. Sly, Southern Indiana Gas & Electric Co.
Fargo, N. D.—L. D. McGuire, Dakota Electric Supply Co.
Ft. Wayne, Ind.—N. G. Smoley, General Electric Co.
Green Bay, Wis.—C. E. Lageman, Wisconsin Public Service Corp.
Independence, Mo. — R. S. Everitt, 107 E. Southside Blvd.
Independence, Kan.—H. J. Winters, Kansas Gas & Electric Co.
Joplin, Mo.—Charles Wells, Empire District Electric Co.
Kansas City, Kan.—J. R. Foley, W. F. Foley Electric Co.
La Crosse, Wis. — C. L. Seaquist, Northern States Power Co.
Lafayette, Ind.—A. M. Smith, Kirby Risk Electric Co.
Lawrence, Kan.—F. H. Elvig, Kansas Electric Power Co.
Madison, Wis. — Arthur J. Von Burg, Wisconsin Power & Light Co.
Madison, Wis.—L. C. Larson, University of Wisconsin
Manhattan, Kan.—O. D. Hunt, Kansas State College
Mason City, Iowa—R. J. Hughes, 22½ Third St., Apt. 4
Muncie, Ind. — John A. Hand, Indiana & Michigan Electric Co.
North Kansas City, Mo.—Charles Owsley, N. Kansas City Electric Co.
Peoria, Ill. — James W. Brown, Central Illinois Light Co.
Peoria, Ill.—James F. Orr, Jr., General Electric Co.
Pittsburgh, Kan.—Carl Liebig, Kansas Gas & Electric Co.
Richmond, Ind.—A. E. Dailey, 12 S. 11 St.
Rochester, Minn.—D. H. Nietz, 30 7th Ave., N. E.
Rockford, Ill. — S. Coxhead, Central Illinois Electric and Gas Co.
St. Joseph, Mo. — S. J. Roberts, St. Joseph Light & Power Co.
South Bend, Ind. — L. F. Stauder, 802 St. Vincent St.
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Ballast
GENERAL ELECTRIC

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GENERAL ELECTRIC

413-87

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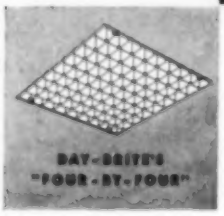

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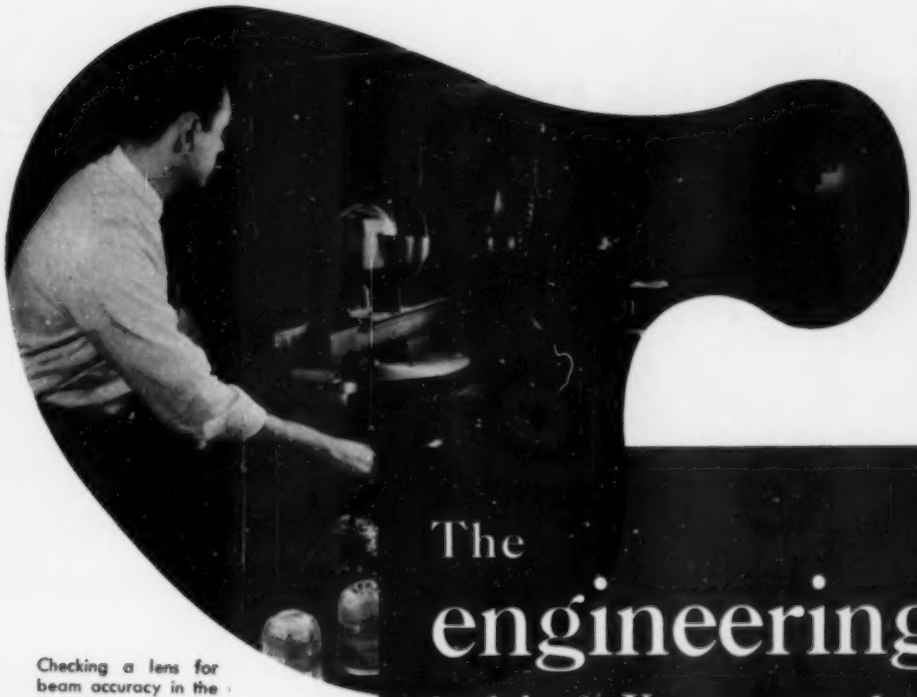

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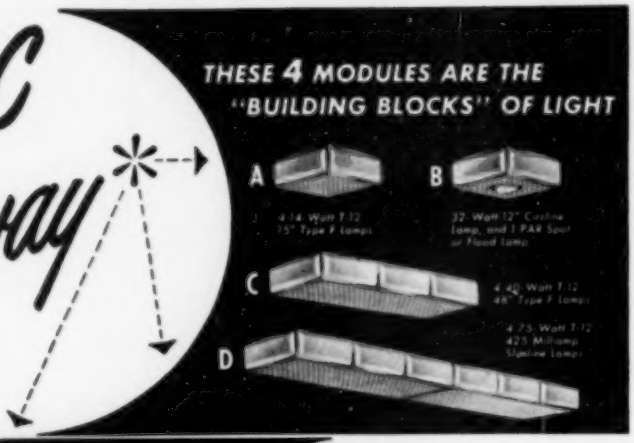
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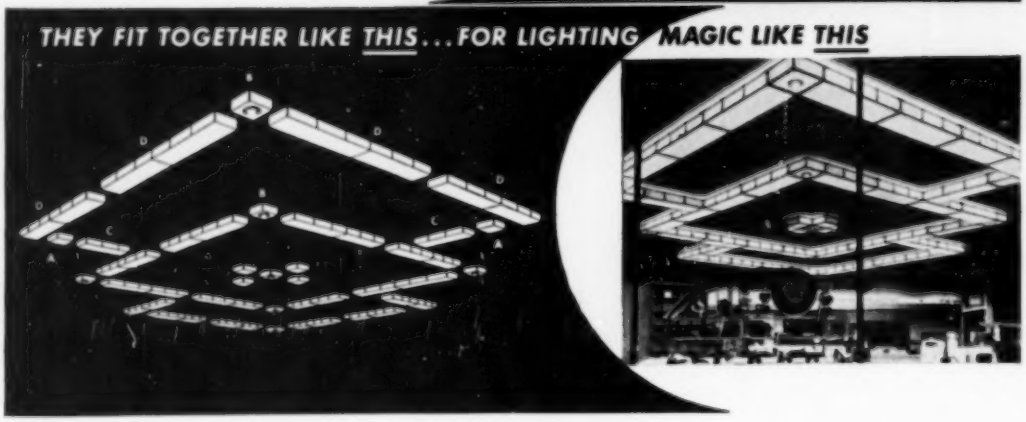

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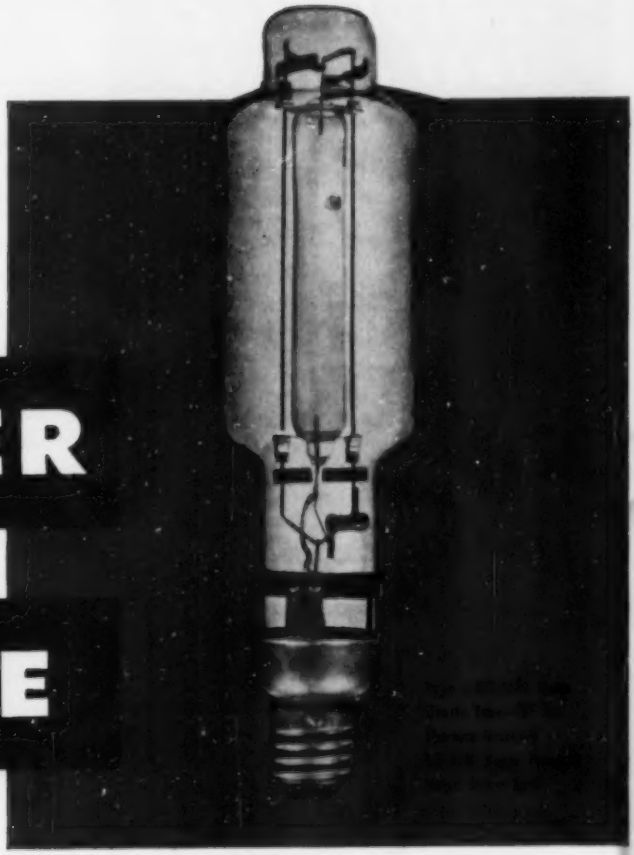

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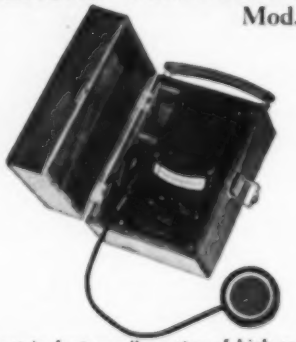

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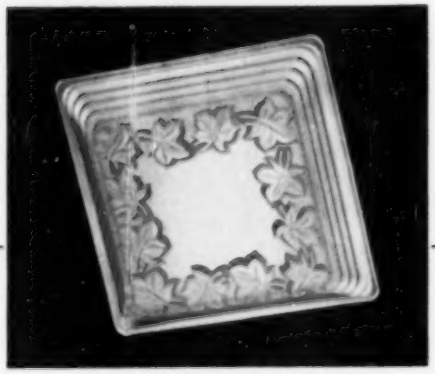

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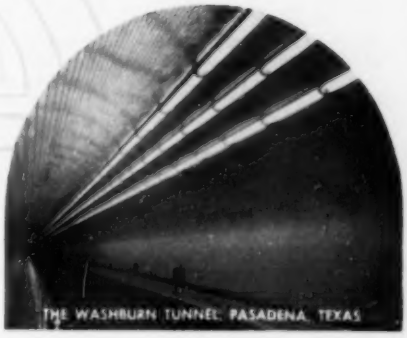

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Specially designed by SUNBEAM to meet tunnel specifications, this Luminaire is constructed entirely of aluminum extrusions and castings. Featuring a one-piece, clear-ribbed polystyrene plastic panel which is supported along its entire length in interlocking aluminum extrusions, this fixture is available with one to four 72" slimline lamps in any milliamp rating including 430 M.A. Over 500 of these units have been installed in the strategically located Washburn Tunnel at Pasadena, Texas. This new 3791-foot vehicular tunnel which burrows beneath the Houston ship channel to link the cities of Pasadena and Galena Park is completely surfaced with glossy ceramic tile and is evenly illuminated by continuous rows of this new unit throughout the full length of the tunnel.

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1 New slimline fixture folder, No. 540, features two-, three- and four-lamp fluorescent luminaires for 40-watt bipin, T-8 and T-12 slimline lamps in 48", 72" and 96" sizes. "Mercury" booklet shows mounting and maintenance as well as technical performance data. Smitheraft Lighting Division, Chelsea, Mass.

2 New catalog on automatically disconnecting and lowering hangers and other fittings and suspension equipment for use with high-bay or inaccessible lighting fixtures. The material is published in loose-leaf form, sectionalized to show dimension diagrams and details of numerous industrial and non-industrial installations, both indoor and outdoor. Thompson Electric Co., Cleveland, Ohio.

3 Fluorescent fixture catalog in 36 pages shows complete line of commercial and industrial fixtures; troffers and strips; as well as recessed incandescent downlights. Coefficients of utilization, reflectance and other pertinent data are included. Leader Electric Co., Chicago, Ill.

4 "Insta-Start" transformer data sheet gives data and specifications on transformer for use with 48" T-12 single and bipin; and 60" T-17 lamps. It is stated that this type of transformer eliminates separate starter and starts instantly, at low ambient temperatures and at lower than standard voltages. France Mfg. Co., Cleveland, Ohio.

5 Bulletin No. 383 describes new line of single-pin slimline fluorescent open type fixtures for either flush or pendant mounting. Units are described as being available in various lengths and in 2-, 3- or 4-lamp styles, and bulletin furnishes data as to coefficients of utilization and light distribution. Mitchell Mfg. Co., Chicago, Ill.

6 New 44-page RLM Specifications booklet contains four new specifications and official revisions of existing standards. The new specifications deal with industrial lighting units utilizing T-12 slimline lamps and include materials, shielding angle, reflector dimensions, etc. RLM Standards Institute, Chicago, Ill.

7 Fluorescent starter data sheet discusses design and operation of preheat type fluorescent lamps; glow-switch and air-thermal type starters with descriptive diagrams. Tables for easy reference compare advantages and disadvantages of all types of starters. Industrial Starter Corp., New York, N. Y.

8 Fixture maintenance and quality booklet "Your Lighting Simplified" shows maintenance features of this company's fluorescent fixtures and gives details on quality of construction, in a simplified approach to these subjects. Edwin F. Guth Co., St. Louis, Mo.

9 Data Sheet DS-24 gives performance and construction details as well as illumination specifications on new wide-spread luminaire with integral bracket for outdoor use. Holophane Co. Inc., New York, N. Y.

10 Catalog of engineering bulletins describes line of commercial and industrial fluorescent luminaires, recessed troffers and strip giving construction details and photos of some installations. Northern Light Co., Milwaukee, Wis.

11 Catalog No. 54 includes technical data, clarifying details and illustrations on all forms of lighting equipment, accessories and devices used in illuminating stage productions, fashion shows, exhibits and entertainments as well as in other fields of illumination. Kliegl Bros., New York, N. Y.

12 Bulletin 455 explains principles of "Luv-R-Lok" fluorescent luminaires with louvers individually removable to facilitate cleaning and general maintenance. Four-page folder furnishes coefficients of utilization and maximum brightness tables. Lighting Products Inc., Highland Park, Ill.

13 Bulletin 749 shows "Powerstat Dimmers," autotransformers for controlling light, to create moods and atmospheres in churches, theaters, clubs, stores, where such lighting is desirable. Booklet features several types made by this company, furnishes ratings and specifications and technical data. Superior Electric Co., Bristol, Conn.

14 Booklet DB-28 explains "Plexoline" system of continuous fluorescent luminaires and describes their adaptation to various lighting needs in stores and showrooms through use of three basic fixtures. Day-Brite Lighting Inc., St. Louis, Mo.

15 Catalog "Incandescent Unified Lighting" in 46 pages shows illustrations of each type of fixture giving cross-section details, light distribution curves, coefficient of utilization tables and other important data. Also offers recommendations for lighting certain areas and spacing and mounting height ratios. Art Metal Co., Cleveland, Ohio.

16 Completely revised catalog SD-179 covering step down transformers and voltage and frequency compensating transformers recently issued. Booklet points out the advantages of using this type of transformer in connection with small motor or individual fluorescent light operation. Acme Electric Corp., Cuba, N. Y.

17 Catalog pages 26-C and 20-A show details of this company's commercial slimline luminaire L-640 and incandescent commercial fixtures in their "2500" series. Features of construction and installation are included as well as charts on illumination factors. Sunbeam Lighting Co., Los Angeles, Calif.

18 36-page booklet "Planning Guide to Improved Plant Lighting" shows industrial executives how gains may be made in terms of reduced production costs through planned lighting. Six steps in planning plant lighting from defining the objective through securing specifications are explained. Benjamin Electric Mfg. Co., Des Plaines, Ill.

19 Catalog on "Abolite" Duo-Move System gives details on systems of incandescent luminaires which embody three separate parts for ease of maintenance; a special hood, a reflector and a changing tool operated direct from floor level, eliminating use of ladders or cranes. Jones Metal Products Co., West Lafayette, Ohio.

20 Folder describes several of this manufacturer's school, commercial and industrial fluorescent fixtures using slimline or cold cathode tubes; furnishes ma ratings, mounting and other specifications in addition to distribution curves and tables of utilization. United Mfg. Co., New Haven, Conn.

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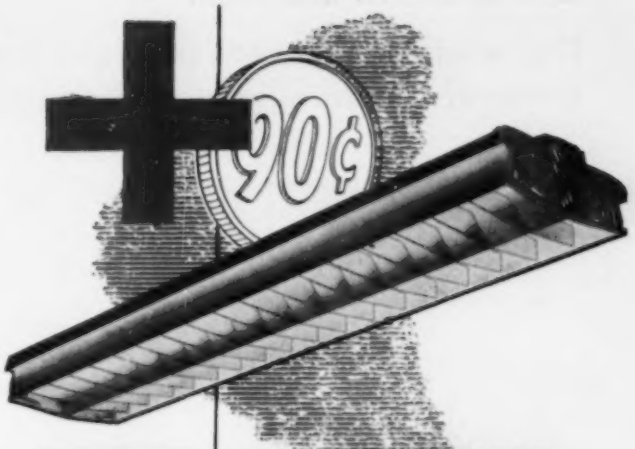

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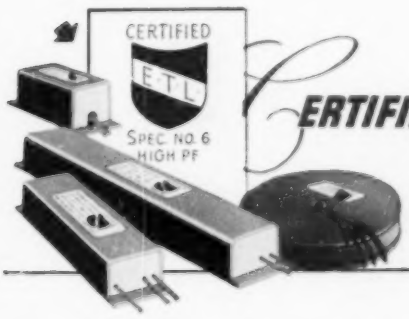

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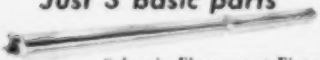
❶ 

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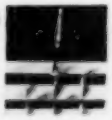
❷ 

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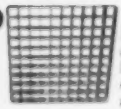
❸ 

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